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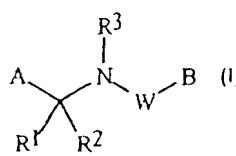
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A2

(54) Title: BENZAMIDES AND ADVANTAGEOUS COMPOSITIONS THEREOF FOR USE AS FUNGICIDES

WO 03/079788



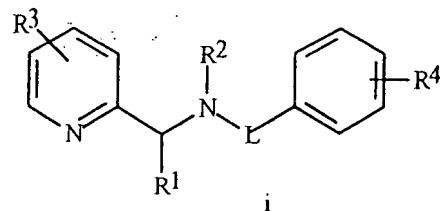
(57) Abstract: Compositions for controlling plant diseases caused by fungal plant pathogens are described, comprising: (a) a fungicidally effective amount of a compound of Formula (I) (including all geometric and stereoisomers, *N*-oxides, and agriculturally suitable salts thereof) wherein A, B, W, R¹, R², and R³ are as defined in the disclosure; and (b) at least one compound selected from the group consisting of (b1) alkylenebis(dithiocarbamate) fungicides; (b2) compounds acting at the bc₁ complex of the fungal mitochondrial respiratory electron transfer site; (b3) cymoxanil; (b4) compounds acting at the demethylase enzyme of the sterol biosynthesis pathway; (b5) morpholine and piperidine compounds that act on the sterol biosynthesis pathway; (b6) phenylamide fungicides; (b7) pyrimidinone fungicides; (b8) phthalimides; and (b9) fosetyl-aluminum. Also disclosed are methods for controlling plant diseases caused by fungal plant pathogens that involves applying an effective amount of the combinations described. Also disclosed are certain compounds of Formula (I).

TITLEBENZAMIDES AND ADVANTAGEOUS COMPOSITIONS THEREOF FOR USE AS
FUNGICIDESBACKGROUND OF THE INVENTION

5 This invention relates to certain benzamides, their *N*-oxides, agriculturally suitable salts, certain advantageous compositions containing a mixture of benzamides and other fungicides and methods of their use as fungicides.

10 The control of plant diseases caused by fungal plant pathogens is extremely important in achieving high crop efficiency. Plant disease damage to ornamental, vegetable, field, cereal, and fruit crops can cause significant reduction in productivity and thereby result in increased costs to the consumer. Many products are commercially available for these purposes, but the need continues for new products that are more effective, less costly, less toxic, or environmentally safer.

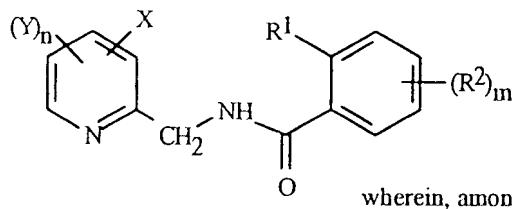
WO 99/42447 discloses certain benzamides of formula i as fungicides



wherein, among others,
R¹ is H, alkyl or acyl;
R² is H or alkyl; and
L is -(C=O)-, -SO₂- or -(C=S)-.

15

WO 02/16322 discloses a novel process for preparing certain benzamides of formula ii that are useful as fungicides



wherein, among others,
X is halogen;
Y is halogen, haloalkyl, alkoxy carbonyl or alkylsulfonyl;
each R¹ and R² is independently halogen;
m is 0, 1 or 2; and
n is 0 to 3.

20 Fungicides that effectively control plant fungi, particularly of the class Oomycetes, such as *Phytophthora* spp. and *Plasmopara* spp., are in constant demand by growers. Combinations of fungicides are often used to facilitate disease control and to retard resistance development. It is desirable to enhance the activity spectrum and the efficacy of disease control by using mixtures of active ingredients that provide a combination of

curative, systemic and preventative control of plant pathogens. Also desirable are combinations that provide greater residual control to allow for extended spray intervals. It is also very desirable to combine fungicidal agents that inhibit different biochemical pathways in the fungal pathogens to retard development of resistance to any one particular plant

5 disease control agent.

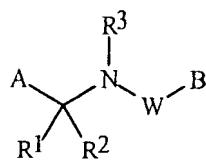
It is in all cases particularly advantageous to be able to decrease the quantity of chemical agents released in the environment while ensuring effective protection of crops from diseases caused by plant pathogens. Mixtures of fungicides may provide significantly better disease control than could be predicted based on the activity of the individual

10 components. This synergism has been described as "the cooperative action of two components of a mixture, such that the total effect is greater or more prolonged than the sum of the effects of the two (or more) taken independently" (see Tames, P. M. L., *Neth. J. Plant Pathology*, (1964), 70, 73-80).

15 There is a desire to find fungicidal agents that are particularly advantageous in achieving one or more of the preceding objectives.

SUMMARY OF THE INVENTION

This invention provides a composition for controlling plant diseases caused by fungal plant pathogens comprising (a) at least one compound of Formula I (including all geometric and stereoisomers), *N*-oxides and agriculturally suitable salts thereof:



I

20

wherein

A is a substituted pyridinyl ring;

B is a substituted phenyl ring;

W is C=L or SO_n;

25 L is O or S;

R¹ and R² are each independently H; or C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl or C₃-C₆ cycloalkyl, each optionally substituted;

30 R³ is H; or C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₃-C₆ cycloalkyl, C₂-C₁₀ alkoxyalkyl, C₂-C₆ alkylcarbonyl, C₂-C₆ alkoxycarbonyl, C₂-C₆ alkylaminocarbonyl or C₃-C₈ dialkylaminocarbonyl; and

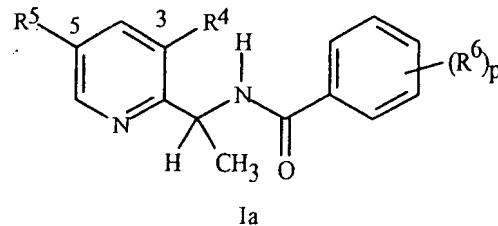
n is 1 or 2; and

(b) at least one compound selected from the group consisting of

- (b1) alkylenebis(dithiocarbamate) fungicides;
- (b2) compounds acting at the bc_1 complex of the fungal mitochondrial respiratory electron transfer site;
- 5 (b3) cymoxanil;
- (b4) compounds acting at the demethylase enzyme of the sterol biosynthesis pathway;
- (b5) morpholine and piperidine compounds that act on the sterol biosynthesis pathway;
- (b6) phenylamide fungicides;
- (b7) pyrimidinone fungicides;
- (b8) phthalimides; and
- 10 (b9) fosetyl-aluminum.

This invention also relates to a method for controlling plant diseases caused by fungal plant pathogens comprising applying to the plant or portion thereof, or to the plant seed or seedling, a fungicidally effective amount of a composition of the invention.

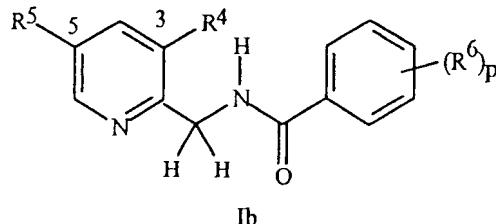
This invention also provides a compound of Formula Ia (including all geometric and 15 stereoisomers), *N*-oxides and agriculturally suitable salts thereof:



wherein

- R^4 is halogen;
- R^5 is C_1 - C_6 alkyl, halogen, NO_2 , C_1 - C_4 alkoxy, C_1 - C_4 haloalkoxy, C_1 - C_4 alkylthio, 20 C_1 - C_4 alkylsulfinyl, C_1 - C_4 alkylsulfonyl, C_1 - C_4 haloalkylthio, C_1 - C_4 haloalkylsulfinyl or C_1 - C_4 haloalkylsulfonyl;
- each R^6 is independently C_1 - C_6 alkyl, C_1 - C_6 haloalkyl, halogen, NO_2 , C_1 - C_4 alkoxy, C_1 - C_4 haloalkoxy, C_1 - C_4 alkylthio, C_1 - C_4 alkylsulfinyl, C_1 - C_4 alkylsulfonyl, 25 C_1 - C_4 haloalkylthio, C_1 - C_4 haloalkylsulfinyl or C_1 - C_4 haloalkylsulfonyl; or
- two R^6 attached to contiguous carbon atoms are taken together with said carbon atoms to form a fused 5- or 6-membered nonaromatic heterocyclic ring containing one or two oxygen atoms and optionally substituted with from one to four substituents independently selected from F or methyl; and
- p is 1, 2, 3 or 4.

30 This invention also provides a compound of Formula Ib (including all geometric and stereoisomers), *N*-oxides and agriculturally suitable salts thereof:



wherein

R⁴ is halogen;

R⁵ is C₁-C₄ haloalkoxy, C₁-C₄ haloalkylthio, C₁-C₄ haloalkylsulfinyl or C₁-C₄ haloalkylsulfonyl;

5

each R⁶ is independently C₁-C₆ alkyl, C₁-C₆ haloalkyl, halogen, NO₂, C₁-C₄ alkoxy, C₁-C₄ haloalkoxy, C₁-C₄ alkylthio, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₁-C₄ haloalkylthio, C₁-C₄ haloalkylsulfinyl or C₁-C₄ haloalkylsulfonyl; or

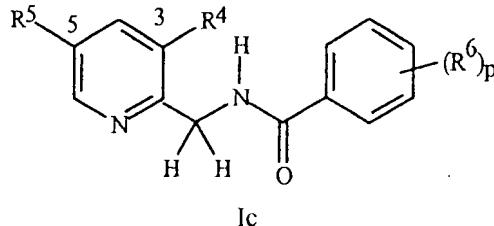
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two R⁶ attached to contiguous carbon atoms are taken together with said carbon atoms to form a fused 5- or 6-membered nonaromatic heterocyclic ring containing one or two oxygen atoms and optionally substituted with from one to four substituents independently selected from F or methyl; and

p is 1, 2, 3 or 4.

15

This invention also provides a compound of Formula Ic (including all geometric and stereoisomers), N-oxides and agriculturally suitable salts thereof:



wherein

R⁴ is Cl or Br;

R⁵ is Br or I;

20

each R⁶ is independently C₁-C₆ alkyl, C₁-C₆ haloalkyl, halogen, NO₂, C₁-C₄ alkoxy, C₁-C₄ haloalkoxy, C₁-C₄ alkylthio, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₁-C₄ haloalkylthio, C₁-C₄ haloalkylsulfinyl or C₁-C₄ haloalkylsulfonyl; or

25

two R⁶ attached to contiguous carbon atoms are taken together with said carbon atoms to form a fused 5- or 6-membered nonaromatic heterocyclic ring containing one or two oxygen atoms and optionally substituted with from one to four substituents independently selected from F or methyl; and

25

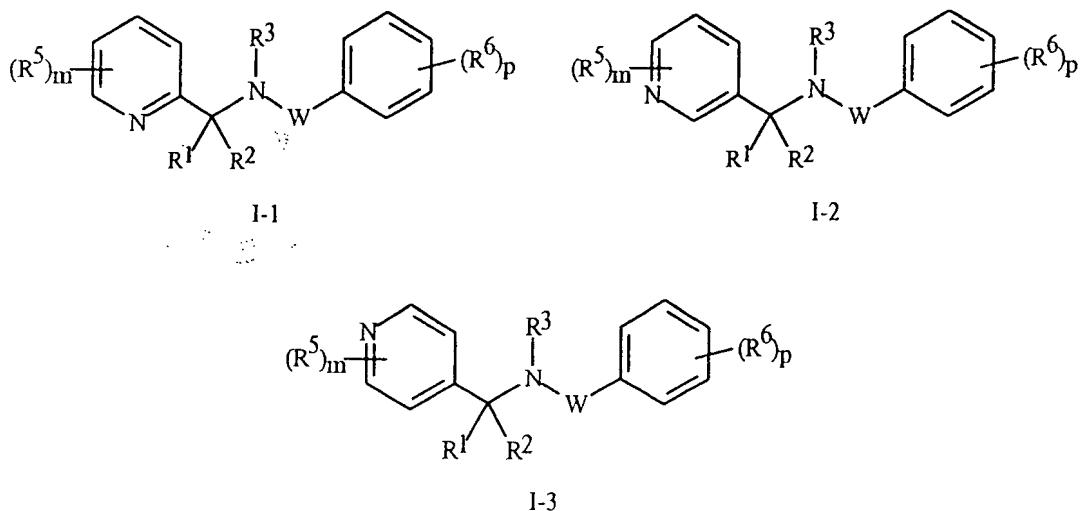
p is 1, 2, 3 or 4.

DETAILS OF THE INVENTION

As noted above, A is a substituted pyridinyl ring and B is a substituted phenyl ring. The term "substituted" in connection with these A or B groups refers to groups that have at least one non-hydrogen substituent that does not extinguish the fungicidal activity.

5 Examples of Formula I incorporating said pyridinyl rings in which A is substituted with 1 to 4 R⁵, B is substituted with 1 to 4 R⁶ include the rings illustrated in Exhibit 1 wherein m and p are independently integers from 1 to 4. Note that the attachment point between (R⁵)_m and A and (R⁶)_p and B is illustrated as floating, and (R⁵)_m and (R⁶)_p can be attached to any available carbon atom of the A and B rings respectively.

10

Exhibit 1

Examples of R⁵ when attached to A and R⁶ when attached to B include:

each R⁵ and R⁶ is independently C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₃-C₆ cycloalkyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₆ halocycloalkyl, halogen, CN, CO₂H, CONH₂, NO₂, hydroxy, C₁-C₄ alkoxy, 15 C₁-C₄ haloalkoxy, C₁-C₄ alkylthio, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₁-C₄ haloalkylthio, C₁-C₄ haloalkylsulfinyl, C₁-C₄ haloalkylsulfonyl, C₁-C₄ alkylamino, C₂-C₈ dialkylamino, C₃-C₆ cycloalkylamino, C₂-C₆ alkylcarbonyl, C₂-C₆ alkoxy carbonyl, C₂-C₆ alkylaminocarbonyl, C₃-C₈ dialkylaminocarbonyl or C₃-C₆ trialkylsilyl; or

15

20

each R⁵ and R⁶ is independently a phenyl, a benzyl, a phenoxy, a 5- or 6-membered heteroaromatic ring or a 5- or 6-membered nonaromatic heterocyclic ring, each ring optionally substituted with from one to three substituents independently selected from R⁷; or

two R⁶ attached to contiguous carbon atoms are taken together with said carbon atoms 25 to form a fused phenyl ring, a fused 5- or 6-membered nonaromatic carbocyclic

ring, a fused 5- or 6-membered heteroaromatic ring or a fused 5- or 6-membered nonaromatic heterocyclic ring, each fused ring optionally substituted with from one to four substituents independently selected from R⁷;

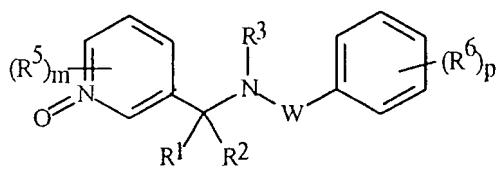
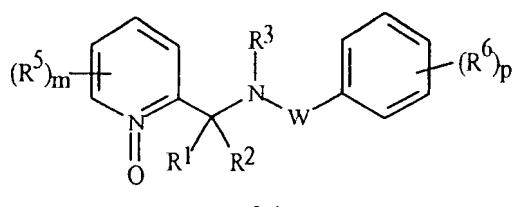
each R⁷ is independently C₁-C₄ alkyl, C₂-C₄ alkenyl, C₂-C₄ alkynyl, C₃-C₆ cycloalkyl, C₁-C₄ haloalkyl, C₂-C₄ haloalkenyl, C₂-C₄ haloalkynyl, C₃-C₆ halocycloalkyl, halogen, CN, NO₂, C₁-C₄ alkoxy, C₁-C₄ haloalkoxy, C₁-C₄ alkylthio, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₁-C₄ alkylamino, C₂-C₈ dialkylamino, C₃-C₆ cycloalkylamino, C₃-C₆ (alkyl)cycloalkylamino, C₂-C₄ alkylcarbonyl, C₂-C₆ alkoxy carbonyl, C₂-C₆ alkylaminocarbonyl, C₃-C₈ dialkylaminocarbonyl or C₃-C₆ trialkylsilyl.

As noted above, R¹ and R² are each independently H; or C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl or C₃-C₆ cycloalkyl, each optionally substituted. The term "optionally substituted" in connection with these R¹ and R² groups refers to groups that are unsubstituted or have at least one non-hydrogen substituent that does not extinguish the fungicidal activity possessed by the unsubstituted analog. Examples of optionally substituted R¹ and R² groups are those that are optionally substituted with one or more substituents selected from the group consisting of halogen, CN, NO₂, hydroxy, C₁-C₄ alkoxy, C₁-C₄ alkylthio, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₂-C₄ alkoxy carbonyl, C₁-C₄ alkylamino, C₂-C₈ dialkylamino and C₃-C₆ cycloalkylamino. Although these substituents are listed in the examples above, it is noted that they do not need to be present since they are optional substituents. Of note are R¹ and R² groups that are optionally substituted with one to four substituents selected from the group above.

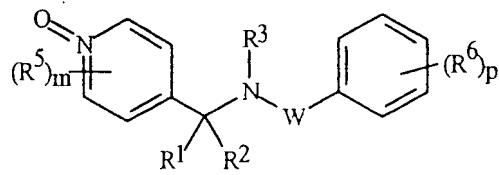
Examples of N-oxides of Formula I are illustrated as I-4 through I-6 in Exhibit 2, wherein R¹, R², R³, R⁵, R⁶, W, m and p are as defined above.

25

Exhibit 2



I-5



I-6

In the above recitations, the term "alkyl", used either alone or in compound words such as "alkylthio" or "haloalkyl" includes straight-chain or branched alkyl, such as, methyl, ethyl, *n*-propyl, *i*-propyl, or the different butyl, pentyl or hexyl isomers. "Alkenyl" includes straight chain or branched alkenes such as ethenyl, 1-propenyl, 2-propenyl, and the different butenyl, pentenyl and hexenyl isomers. "Alkenyl" also includes polyenes such as 5 1,2-propadienyl and 2,4-hexadienyl. "Alkynyl" includes straight chain or branched alkynes such as ethynyl, 1-propynyl, 2-propynyl and the different butynyl, pentynyl and hexynyl isomers. "Alkynyl" can also include moieties comprised of multiple triple bonds such as 10 2,5-hexadiynyl. "Alkoxy" includes, for example, methoxy, ethoxy, *n*-propyloxy, isopropyloxy and the different butoxy, pentoxy and hexyloxy isomers. "Alkoxyalkyl" denotes alkoxy substitution on alkyl. Examples of "alkoxyalkyl" include CH_3OCH_2 , $\text{CH}_3\text{OCH}_2\text{CH}_2$, $\text{CH}_3\text{CH}_2\text{OCH}_2$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OCH}_2$ and $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_2$. "Alkoxyalkoxy" denotes alkoxy substitution on alkoxy. The term "Alkenyloxy" includes 15 straight chain or branched alkenyloxy moieties. Examples of "alkenyloxy" include $\text{H}_2\text{C}=\text{CHCH}_2\text{O}$, $(\text{CH}_3)_2\text{C}=\text{CHCH}_2\text{O}$, $(\text{CH}_3)\text{CH}=\text{CHCH}_2\text{O}$, $(\text{CH}_3)\text{CH}=\text{C}(\text{CH}_3)\text{CH}_2\text{O}$ and $\text{CH}_2=\text{CHCH}_2\text{CH}_2\text{O}$. "Alkynyloxy" includes straight chain or branched alkynyloxy moieties. Examples of "alkynyloxy" include $\text{HC}\equiv\text{CCH}_2\text{O}$, $\text{CH}_3\text{C}\equiv\text{CCH}_2\text{O}$ and 20 $\text{CH}_3\text{C}\equiv\text{CCH}_2\text{CH}_2\text{O}$. "Alkylthio" includes branched or straight chain alkylthio moieties such as methylthio, ethylthio, and the different propylthio, butylthio, pentylthio and hexylthio isomers. "Alkylsulfinyl" includes both enantiomers of an alkylsulfinyl group. Examples of 25 "alkylsulfinyl" include $\text{CH}_3\text{S}(\text{O})$, $\text{CH}_3\text{CH}_2\text{S}(\text{O})$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{S}(\text{O})$, $(\text{CH}_3)_2\text{CHS}(\text{O})$ and the different butylsulfinyl, pentylsulfinyl and hexylsulfinyl isomers. Examples of "alkylsulfonyl" include $\text{CH}_3\text{S}(\text{O})_2$, $\text{CH}_3\text{CH}_2\text{S}(\text{O})_2$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{S}(\text{O})_2$, $(\text{CH}_3)_2\text{CHS}(\text{O})_2$ and the different butylsulfonyl, pentylsulfonyl and hexylsulfonyl isomers. "Alkylamino", "dialkylamino", "alkenylthio", "alkenylsulfinyl", "alkenylsulfonyl", "alkynylthio", "alkynylsulfinyl", "alkynylsulfonyl", and the like, are defined analogously to the above examples. "Cycloalkyl" includes, for example, cyclopropyl, cyclobutyl, cyclopentyl, and cyclohexyl. The term "cycloalkoxy" includes the same groups linked through an oxygen atom such as cyclopentyloxy and cyclohexyloxy.

30 The term "halogen", either alone or in compound words such as "haloalkyl", includes fluorine, chlorine, bromine or iodine. Further, when used in compound words such as "haloalkyl", said alkyl may be partially or fully substituted with halogen atoms which may be the same or different. Examples of "haloalkyl" include F_3C , ClCH_2 , CF_3CH_2 and CF_3CCl_2 . The terms "haloalkenyl", "haloalkynyl", "haloalkoxy", "haloalkylthio", and the like, are defined analogously to the term "haloalkyl". Examples of "haloalkenyl" include 35 $(\text{Cl})_2\text{C}=\text{CHCH}_2$ and $\text{CF}_3\text{CH}_2\text{CH}=\text{CHCH}_2$. Examples of "haloalkynyl" include $\text{HC}\equiv\text{CCHCl}$, $\text{CF}_3\text{C}\equiv\text{C}$, $\text{CCl}_3\text{C}\equiv\text{C}$ and $\text{FCH}_2\text{C}\equiv\text{CCH}_2$. Examples of "haloalkoxy" include CF_3O , $\text{CCl}_3\text{CH}_2\text{O}$, $\text{HCF}_2\text{CH}_2\text{CH}_2\text{O}$ and $\text{CF}_3\text{CH}_2\text{O}$. Examples of "haloalkylthio" include CCl_3S ,

CF₃S, CCl₃CH₂S and ClCH₂CH₂CH₂S. Examples of "haloalkylsulfinyl" include CF₃S(O), CCl₃S(O), CF₃CH₂S(O) and CF₃CF₂S(O). Examples of "haloalkylsulfonyl" include CF₃S(O)₂, CCl₃S(O)₂, CF₃CH₂S(O)₂ and CF₃CF₂S(O)₂. Examples of "alkylcarbonyl" include C(O)CH₃, C(O)CH₂CH₂CH₃ and C(O)CH(CH₃)₂. Examples of "alkoxycarbonyl" include CH₃OC(=O), CH₃CH₂OC(=O), CH₃CH₂CH₂OC(=O), (CH₃)₂CHOC(=O) and the different butoxy- or pentoxy carbonyl isomers.

"Aromatic" indicates that each of the ring atoms is essentially in the same plane and has a *p*-orbital perpendicular to the ring plane, and in which (4n + 2) π electrons, when n is 0 or a positive integer, are associated with the ring to comply with Hückel's rule. The term "aromatic carbocyclic ring" includes fully aromatic carbocycles (e.g. phenyl). The term "nonaromatic carbocyclic ring" denotes fully saturated carbocycles as well as partially or fully unsaturated carbocycles where the Hückel rule is not satisfied. The term "hetero" in connection with rings refers to a ring in which at least one ring atom is not carbon and which can contain 1 to 4 heteroatoms independently selected from the group consisting of nitrogen, 10 oxygen and sulfur, provided that each ring contains no more than 4 nitrogens, no more than 2 oxygens and no more than 2 sulfurs. The terms "heteroaromatic ring" includes fully aromatic heterocycles. The term "nonaromatic heterocyclic ring" denotes fully saturated heterocycles as well as partially or fully unsaturated heterocycles where the Hückel rule is not satisfied. The heterocyclic ring can be attached through any available carbon or nitrogen 15 by replacement of a hydrogen on said carbon or nitrogen.

One skilled in the art will appreciate that not all nitrogen containing heterocycles can form *N*-oxides since the nitrogen requires an available lone pair for oxidation to the oxide; one skilled in the art will recognize those nitrogen containing heterocycles which can form *N*-oxides. One skilled in the art will also recognize that tertiary amines can form *N*-oxides. 20 Synthetic methods for the preparation of *N*-oxides of heterocycles and tertiary amines are very well known by one skilled in the art including the oxidation of heterocycles and tertiary amines with peroxy acids such as peracetic and *m*-chloroperbenzoic acid (MCPBA), 25 hydrogen peroxide, alkyl hydroperoxides such as *t*-butyl hydroperoxide, sodium perborate, and dioxiranes such as dimethyldioxirane. These methods for the preparation of *N*-oxides have been extensively described and reviewed in the literature, see for example:

T. L. Gilchrist in *Comprehensive Organic Synthesis*, vol. 7, pp 748-750, S. V. Ley, Ed., Pergamon Press; M. Tisler and B. Stanovnik in *Comprehensive Heterocyclic Chemistry*, vol. 3, pp 18-20, A. J. Boulton and A. McKillop, Eds., Pergamon Press; M. R. Grimmett and B. R. T. Keene in *Advances in Heterocyclic Chemistry*, vol. 43, pp 149-161, A. R. Katritzky, 35 Ed., Academic Press; M. Tisler and B. Stanovnik in *Advances in Heterocyclic Chemistry*, vol. 9, pp 285-291, A. R. Katritzky and A. J. Boulton, Eds., Academic Press; and G. W. H. Cheeseman and E. S. G. Werstiuk in *Advances in Heterocyclic Chemistry*, vol. 22, pp 390-392, A. R. Katritzky and A. J. Boulton, Eds., Academic Press.

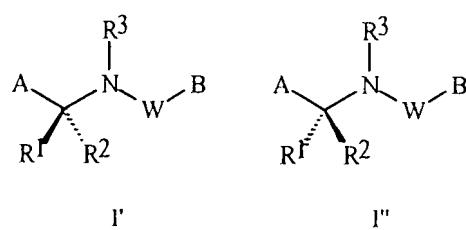
The total number of carbon atoms in a substituent group is indicated by the "C_i-C_j" prefix where i and j are numbers from 1 to 8. For example, C₁-C₃ alkylsulfonyl designates methylsulfonyl through propylsulfonyl; C₂ alkoxyalkyl designates CH₃OCH₂; C₃ alkoxyalkyl designates, for example, CH₃CH(OCH₃), CH₃OCH₂CH₂ or CH₃CH₂OCH₂; and C₄ alkoxyalkyl designates the various isomers of an alkyl group substituted with an alkoxy group containing a total of four carbon atoms, examples including CH₃CH₂CH₂OCH₂ and CH₃CH₂OCH₂CH₂.

When a compound is substituted with a substituent bearing a subscript that indicates the number of said substituents can exceed 1, said substituents (when they exceed 1) are independently selected from the group of defined substituents. Further, when the subscript indicates a range, e.g. (R)_{i-j}, then the number of substituents may be selected from the integers between i and j inclusive.

When a group contains a substituent which can be hydrogen, for example R¹ or R² then, when this substituent is taken as hydrogen, it is recognized that this is equivalent to said group being unsubstituted.

Compounds of Formula I can exist as one or more stereoisomers. The various stereoisomers include enantiomers, diastereomers, atropisomers and geometric isomers. One skilled in the art will appreciate that one stereoisomer may be more active and/or may exhibit beneficial effects when enriched relative to the other stereoisomer(s) or when separated from the other stereoisomer(s). Additionally, the skilled artisan knows how to separate, enrich, and/or to selectively prepare said stereoisomers. Accordingly, the present invention comprises compounds selected from Formula I, N-oxides and agriculturally suitable salts thereof. The compounds of Formula I may be present as a mixture of stereoisomers, individual stereoisomers, or as an optically active form. In particular, when R¹ and R² of Formula I are different, then said Formula possesses a chiral center at the carbon to which R¹ and R² are commonly bonded.

This invention includes racemic mixtures of equal parts of Formula I' and Formula I".



wherein A, B W, R¹, R² and R³ are as defined above.

In addition, this invention includes compositions that are enriched compared to the racemic mixture in an enantiomer of the Formula I' or Formula I". This invention also includes compositions wherein component (a) is enriched in a component (a) enantiomer of

Formula I' compared to the racemic mixture of component (a). Included are compositions comprising the essentially pure enantiomers of Formula I'. This invention also includes compositions wherein component (a) is enriched in a component (a) enantiomer of Formula I" compared to the racemic mixture of component (a). Included are compositions comprising the essentially pure enantiomers of Formula I".

When enantiomerically enriched, one enantiomer is present in greater amounts than the other and the extent of enrichment can be defined by an expression of enantiomer excess("ee"), which is defined as $100(2x-1)$ where x is the mole fraction of the dominant enantiomer in the enantiomer mixture (e.g., an ee of 20% corresponds to a 60:40 ratio of enantiomers).

The more active enantiomer with respect to the relative positions of R¹, R², A and the rest of the molecule bonded through nitrogen corresponds to the configuration of the enantiomer of Formula I that, when in a solution of CDCl₃, rotates plane polarized light in the (+) or *dextro* direction.

Preferably there is at least a 50% enantiomeric excess; more preferably at least a 75 % enantiomeric excess; still more preferably at least a 90% enantiomeric excess; and the most preferably at least a 94% enantiomeric excess of the more active isomer of Formula I. Of particular note are enantiomerically pure embodiments of the more active isomer of Formula I.

The salts of the compounds of Formula I include acid-addition salts with inorganic or organic acids such as hydrobromic, hydrochloric, nitric, phosphoric, sulfuric, acetic, butyric, fumaric, lactic, maleic, malonic, oxalic, propionic, salicylic, tartaric, 4-toluenesulfonic or valeric acids. The salts of the compounds of Formula I also include those formed with organic bases (e.g., pyridine, ammonia, or triethylamine) or inorganic bases (e.g., hydrides, hydroxides, or carbonates of sodium, potassium, lithium, calcium, magnesium or barium) when the compound contains an acidic group such as a carboxylic acid or phenol.

Preferred compositions of the invention, wherein (a) comprises compounds of Formula I, for reasons of better activity and/or ease of synthesis are:

Preferred 1. Preferred are compositions wherein in Formula I

A is a pyridinyl ring substituted with from 1 to 4 R⁵;

B is a phenyl ring substituted with from 1 to 4 R⁶;

W is C=O;

R¹ and R² are each independently H; or C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆

alkynyl or C₃-C₆ cycloalkyl, each optionally substituted with one or

more substituents selected from the group consisting of halogen, CN,

NO₂, hydroxy, C₁-C₄ alkoxy, C₁-C₄ alkylthio, C₁-C₄ alkylsulfinyl,

C₁-C₄ alkylsulfonyl, C₂-C₄ alkoxy carbonyl, C₁-C₄ alkylamino, C₂-C₈

dialkylamino and C₃-C₆ cycloalkylamino;

R³ is H; and

each R⁵ and R⁶ is independently C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₃-C₆ cycloalkyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₆ halocycloalkyl, halogen, CN, CO₂H, CONH₂, NO₂, hydroxy, C₁-C₄ alkoxy, C₁-C₄ haloalkoxy, C₁-C₄ alkylthio, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₁-C₄ haloalkylthio, C₁-C₄ haloalkylsulfinyl, C₁-C₄ haloalkylsulfonyl, C₁-C₄ alkylamino, C₂-C₈ dialkylamino, C₃-C₆ cycloalkylamino, C₂-C₆ alkylcarbonyl, C₂-C₆ alkoxy carbonyl, C₂-C₆ alkylaminocarbonyl, C₃-C₈ dialkylaminocarbonyl or C₃-C₆ trialkylsilyl; or

each R⁵ and R⁶ is independently a phenyl, a benzyl, a phenoxy, a 5- or 6-membered heteroaromatic ring or a 5- or 6-membered nonaromatic heterocyclic ring, each ring optionally substituted with one to three substituents independently selected from R⁷; or

two R⁶ attached to contiguous carbon atoms are taken together with said carbon atoms to form a fused phenyl ring, a fused 5- or 6-membered nonaromatic carbocyclic ring, a fused 5- or 6-membered heteroaromatic ring or a fused 5- or 6-membered nonaromatic heterocyclic ring, each fused ring optionally substituted with one to four substituents independently selected from R⁷; and

each R⁷ is independently C₁-C₄ alkyl, C₂-C₄ alkenyl, C₂-C₄ alkynyl, C₃-C₆ cycloalkyl, C₁-C₄ haloalkyl, C₂-C₄ haloalkenyl, C₂-C₄ haloalkynyl, C₃-C₆ halocycloalkyl, halogen, CN, NO₂, C₁-C₄ alkoxy, C₁-C₄ haloalkoxy, C₁-C₄ alkylthio, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₁-C₄ alkylamino, C₂-C₈ dialkylamino, C₃-C₆ cycloalkylamino, C₃-C₆ (alkyl)cycloalkylamino, C₂-C₄ alkylcarbonyl, C₂-C₆ alkoxy carbonyl, C₂-C₆ alkylaminocarbonyl, C₃-C₈ dialkylaminocarbonyl or C₃-C₆ trialkylsilyl.

Of note are compositions of Preferred 1 wherein A is a substituted 3-pyridinyl ring.

Preferred 2. Compositions of Preferred 1 wherein

A is a 2-pyridinyl ring substituted with from 1 to 4 R⁵; and

B is substituted with from 1 to 4 R⁶, with at least one R⁶ located in a position *ortho* to the link with W.

Of note are compositions wherein each R⁶ is independently F, Cl, Br, I, CH₃, OCH₃, OCF₃, OCHF₂, CF₃ or NO₂. Also of note are compositions wherein at least one R⁶ is iodo.

Preferred 3. Compositions of Preferred 2 wherein B is substituted with an R⁶ at each position *ortho* to the link with W, and optionally one additional R⁶, and each R⁶ is independently F, Cl, Br, I, CH₃, OCH₃ or CF₃.

Of note are compositions wherein each R⁶ is either halogen or methyl.

Preferred 4. Compositions of Preferred 3 wherein B is substituted with one R⁶ as a Cl located at the 2-position *ortho* to the link with W, another R⁶ is selected from Cl or methyl and is located at the 6-position *ortho* to the link with W and a third optional R⁶ is methyl at the 4-position.

Preferred 5. Compositions of Preferred 4 wherein A is 3-chloro-5-CF₃-2-pyridinyl.

Preferred compositions of this invention include those of Preferred 1 through Preferred 5 wherein R¹ is H and R² is H or CH₃. More preferred are compositions of Preferred 1 through Preferred 5 wherein R¹ is H and R² is CH₃.

10 Specifically preferred are compositions comprising a compound selected from the group consisting of

2,6-dichloro-N-[[3-chloro-5-(trifluoromethyl)-2-pyridinyl]methyl]benzamide,
 2,6-dichloro-N-[1-[3-chloro-5-(trifluoromethyl)-2-pyridinyl]ethyl]benzamide,
 2,6-dichloro-N-[[3-chloro-5-(trifluoromethyl)-2-pyridinyl]methyl]-4-
 15 methylbenzamide,
 2,6-dichloro-N-[1-[3-chloro-5-(trifluoromethyl)-2-pyridinyl]ethyl]-4-
 methylbenzamide,
 2,6-dichloro-N-[(3,5-dichloro-2-pyridinyl)methyl]benzamide,
 2,6-dichloro-N-[1-(3,5-dichloro-2-pyridinyl)ethyl]benzamide,
 20 2,6-dichloro-N-[(3,5-dichloro-2-pyridinyl)methyl]-4-methylbenzamide, and
 2,6-dichloro-N-[1-(3,5-dichloro-2-pyridinyl)ethyl]-4-methylbenzamide.

Of note are compositions comprising a compound selected from the group consisting

of

2,6-dichloro-N-[[3-chloro-5-(trifluoromethyl)-2-pyridinyl]methyl]benzamide (also
 25 known as N-[(3-chloro-5-trifluoromethyl-2-pyridyl)methyl]-2,6-
 dichlorobenzamide),
 N-[(3-chloro-5-(trifluoromethyl)-2-pyridinyl)methyl]-2,6-difluorobenzamide (also
 known as N-[(3-chloro-5-trifluoromethyl-2-pyridyl)methyl]-2,6-
 30 difluorobenzamide),
 2-chloro-N-[[3-chloro-5-(trifluoromethyl)-2-pyridinyl]methyl]-6-fluorobenzamide
 (also known as N-[(3-chloro-5-trifluoromethyl-2-pyridyl)methyl]-2-chloro-6-
 fluorobenzamide),
 N-[(3-chloro-5-(trifluoromethyl)-2-pyridinyl)methyl]-2,3-difluorobenzamide (also
 known as N-[(3-chloro-5-trifluoromethyl-2-pyridyl)methyl]-2,3-
 35 difluorobenzamide),
 N-[(3-chloro-5-(trifluoromethyl)-2-pyridinyl)methyl]-2,4,6-trifluorobenzamide
 (also known as N-[(3-chloro-5-trifluoromethyl-2-pyridyl)methyl]-2,4,6-
 trifluorobenzamide), and

2-bromo-6-chloro-*N*-[[3-chloro-5-(trifluoromethyl)-2-pyridinyl]methyl]benzamide (also known as *N*-[(3-chloro-5-trifluoromethyl-2-pyridyl)methyl]-2-bromo-6-chlorobenzamide).

This invention also relates to a method for controlling plant diseases caused by fungal 5 plant pathogens comprising applying to the plant or portion thereof, or to the plant seed or seedling, a fungicidally effective amount of the composition of the invention (i.e., as a composition described herein). The preferred methods of use are those involving the above-preferred compositions.

This invention also provides a compound of Formula Ia as described above. Preferred 10 compounds of Formula Ia are:

Preferred A. Compounds of Formula Ia wherein R⁵ is Cl, Br, I, CH₃, OCF₃, OCHF₂, OCH₂CF₃, OCF₂CF₃, OCF₂CF₂H, OCHFCF₃, SCF₃, SCHF₂, SCH₂CF₃, SCF₂CF₃, SCF₂CF₂H, SCHFCF₃, SOCF₃, SOCHF₂, SOCH₂CF₃, SOCF₂CF₃, SOCF₂CF₂H, SOCHFCF₃, SO₂CF₃, SO₂CHF₂, SO₂CH₂CF₃, SO₂CF₂CF₃, SO₂CF₂CF₂H or 15 SO₂CHFCF₃.

Preferred B. Compounds of Preferred A wherein at least one R⁶ is located in a position *ortho* to the link with the C=O moiety and each R⁶ is independently F, Cl, Br, I, CH₃, OCH₃, OCF₃, OCHF₂, CF₃ or NO₂.

Preferred C. Compounds of Preferred B wherein there is an R⁶ at each position *ortho* to 20 the link with the C=O moiety, and optionally one additional R⁶, and each R⁶ is independently F, Cl, Br, I, CH₃, OCH₃ or CF₃.

This invention also provides a compound of Formula Ib as described above. Preferred compounds of Formula Ib are:

Preferred D. Compounds of Formula Ib wherein R⁵ is, OCF₃, OCHF₂, OCH₂CF₃, 25 OCF₂CF₃, OCF₂CF₂H, OCHFCF₃, SCF₃, SCHF₂, SCH₂CF₃, SCF₂CF₃, SCF₂CF₂H, SCHFCF₃, SOCF₃, SOCHF₂, SOCH₂CF₃, SOCF₂CF₃, SOCF₂CF₂H, SOCHFCF₃, SO₂CF₃, SO₂CHF₂, SO₂CH₂CF₃, SO₂CF₂CF₃, SO₂CF₂CF₂H or SO₂CHFCF₃.

Preferred E. Compounds of Preferred D wherein at least one R⁶ is located in a position *ortho* to the link with the C=O moiety and each R⁶ is independently F, Cl, Br, I, 30 CH₃, OCH₃, OCF₃, OCHF₂, CF₃ or NO₂.

Preferred F. Compounds of Preferred E wherein there is an R⁶ at each position *ortho* to the link with the C=O moiety, and optionally one additional R⁶, and each R⁶ is independently F, Cl, Br, I, CH₃, OCH₃ or CF₃.

This invention also provides a compound of Formula Ic as described above. Preferred 35 compounds of Formula Ic are:

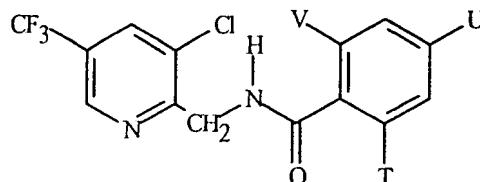
Preferred G. Compounds of Formula Ic wherein at least one R⁶ is located in a position *ortho* to the link with the C=O moiety and each R⁶ is independently F, Cl, Br, I, CH₃, OCH₃, OCF₃, OCHF₂, CF₃ or NO₂.

Preferred H. Compounds of Preferred G wherein there is an R⁶ at each position *ortho* to the link with the C=O moiety, and optionally one additional R⁶, and each R⁶ is independently F, Cl, Br, I, CH₃, OCH₃ or CF₃.

Compounds of Formula I can be prepared by one or more of the methods and variations described in WO99/42447 (See e.g., Example 4). Some compounds of Formula I can also be prepared by methods described in WO02/16322.

Examples of compounds of Formula I suitable for use in component (a) of the compositions of this invention include the following compounds of Tables 1-7. The following abbreviations are used in the Tables which follow: Me is methyl, Et is ethyl, Ph is phenyl, OMe is methoxy, OEt is ethoxy, CN is cyano, NO₂ is nitro. The substituents Q and R are equivalent to independent R⁵ substituents that have been located in the positions indicated. The substituents T, U and V are equivalent to independent R⁶ substituents that have been located in the positions indicated.

Table 1



15

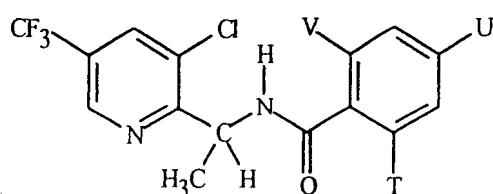
T	U	V	T	U	V	T	U	V	T	U	V
Me	Me	Me	OMe	Me	Me	Cl	NO ₂	Me	Br	Me	Me
Me	Me	F	OMe	Me	F	Cl	NO ₂	F	Br	Me	F
Me	Me	Cl	OMe	Me	Cl	Cl	NO ₂	Cl	Br	Me	Cl
Me	Me	Br	OMe	Me	Br	Cl	NO ₂	Br	Br	Me	Br
Me	Me	CF ₃	OMe	Me	CF ₃	Cl	NO ₂	CF ₃	Br	Me	CF ₃
Me	Me	NO ₂	OMe	Me	NO ₂	Cl	NO ₂	NO ₂	Br	Me	NO ₂
Me	Me	OMe	OMe	Me	OMe	Cl	NO ₂	OMe	Br	Me	OMe
F	Me	Me	OMe	F	Me	CF ₃	OMe	Me	CF ₃	Me	Me
F	Me	F	OMe	F	F	CF ₃	OMe	F	CF ₃	Me	F
F	Me	Cl	OMe	F	Cl	CF ₃	OMe	Cl	CF ₃	Me	Cl
F	Me	Br	OMe	F	Br	CF ₃	OMe	Br	CF ₃	Me	Br
F	Me	CF ₃	OMe	F	CF ₃	CF ₃	OMe	CF ₃	CF ₃	Me	CF ₃
F	Me	NO ₂	OMe	F	NO ₂	F	OMe	Me	CF ₃	Me	NO ₂
F	Me	OMe	OMe	F	OMe	F	OMe	F	CF ₃	Me	OMe
Cl	Me	Me	OMe	Cl	Me	F	OMe	Cl	NO ₂	Me	Me
Cl	Me	F	OMe	Cl	F	F	OMe	Br	NO ₂	Me	F
Cl	Me	Cl	OMe	Cl	Cl	F	OMe	CF ₃	NO ₂	Me	Cl

T	U	V	T	U	V	T	U	V	T	U	V
Cl	Me	Br	OMe	Cl	Br	F	OMe	NO ₂	NO ₂	Me	Br
Cl	Me	CF ₃	OMe	Cl	CF ₃	F	OMe	OMe	NO ₂	Me	CF ₃
Cl	Me	NO ₂	OMe	Cl	NO ₂	CF ₃	OMe	NO ₂	NO ₂	Me	NO ₂
Cl	Me	OMe	OMe	Cl	OMe	CF ₃	OMe	OMe	NO ₂	Me	OMe
Me	F	Me	OMe	H	Me	Br	OMe	NO ₂	Br	F	Me
Me	F	F	OMe	H	F	Br	OMe	OMe	Br	F	F
Me	F	Cl	OMe	H	Cl	NO ₂	NO ₂	Me	Br	F	Cl
Me	F	Br	OMe	H	OMe	NO ₂	NO ₂	F	Br	F	Br
Me	F	CF ₃	OMe	OMe	CF ₃	NO ₂	NO ₂	Cl	Br	F	CF ₃
Me	F	NO ₂	OMe	OMe	NO ₂	NO ₂	NO ₂	Br	Br	F	NO ₂
Me	F	OMe	OMe	OMe	OMe	NO ₂	NO ₂	CF ₃	Br	F	OMe
F	F	Me	OMe	Br	Me	NO ₂	NO ₂	NO ₂	CF ₃	F	Me
F	F	F	OMe	Br	F	NO ₂	NO ₂	OMe	CF ₃	F	F
F	F	Cl	OMe	Br	Cl	Br	OMe	Me	CF ₃	F	Cl
F	F	Br	OMe	Br	Br	Br	OMe	F	CF ₃	F	Br
F	F	CF ₃	OMe	Br	CF ₃	Br	OMe	Cl	CF ₃	F	CF ₃
F	F	NO ₂	OMe	Br	NO ₂	Br	OMe	Br	CF ₃	F	NO ₂
F	F	OMe	OMe	Br	OMe	Br	OMe	CF ₃	CF ₃	F	OMe
Cl	F	Me	OMe	CF ₃	Me	Me	NO ₂	Me	NO ₂	F	Me
Cl	F	F	OMe	CF ₃	F	Me	NO ₂	F	NO ₂	F	F
Cl	F	Cl	OMe	CF ₃	Cl	Me	NO ₂	Cl	NO ₂	F	Cl
Cl	F	Br	OMe	CF ₃	Br	Me	NO ₂	Br	NO ₂	F	Br
Cl	F	CF ₃	OMe	CF ₃	CF ₃	Me	NO ₂	CF ₃	NO ₂	F	CF ₃
Cl	F	NO ₂	OMe	CF ₃	NO ₂	Me	NO ₂	NO ₂	NO ₂	F	NO ₂
Cl	F	OMe	OMe	CF ₃	OMe	Me	NO ₂	OMe	NO ₂	F	OMe
Me	Cl	Me	OMe	NO ₂	Me	F	NO ₂	Me	Br	Cl	Me
Me	Cl	F	OMe	NO ₂	F	F	NO ₂	F	Br	Cl	F
Me	Cl	Cl	OMe	NO ₂	Cl	F	NO ₂	Cl	Br	Cl	Cl
Me	Cl	Br	OMe	NO ₂	Br	F	NO ₂	Br	Br	Cl	Br
Me	Cl	CF ₃	OMe	NO ₂	CF ₃	F	NO ₂	CF ₃	Br	Cl	CF ₃
Me	Cl	NO ₂	OMe	NO ₂	NO ₂	F	NO ₂	NO ₂	Br	Cl	NO ₂
Me	Cl	OMe	OMe	NO ₂	OMe	F	NO ₂	OMe	Br	Cl	OMe
F	Cl	Me	OMe	H	Br	Br	H	Me	CF ₃	Cl	Me
F	Cl	F	OMe	H	CF ₃	Br	H	F	CF ₃	Cl	F
F	Cl	Cl	OMe	H	NO ₂	Br	H	Cl	CF ₃	Cl	Cl
F	Cl	Br	OMe	OMe	Me	Br	H	Br	CF ₃	Cl	Br
F	Cl	CF ₃	OMe	OMe	F	Br	H	CF ₃	CF ₃	Cl	CF ₃

T	U	V	T	U	V	T	U	V	T	U	V
F	Cl	NO ₂	OMe	OMe	Cl	Br	H	NO ₂	CF ₃	Cl	NO ₂
F	Cl	OMe	OMe	OMe	Br	Br	H	OMe	CF ₃	Cl	OMe
Cl	Cl	Me	F	H	Me	Me	OMe	Me	NO ₂	Cl	Me
Cl	Cl	F	F	H	F	Me	OMe	F	NO ₂	Cl	F
Cl	Cl	Cl	F	H	Cl	Me	OMe	Cl	NO ₂	Cl	Cl
Cl	Cl	Br	F	H	Br	Me	OMe	Br	NO ₂	Cl	Br
Cl	Cl	CF ₃	F	H	CF ₃	Me	OMe	CF ₃	NO ₂	Cl	CF ₃
Cl	Cl	NO ₂	F	H	NO ₂	Me	OMe	NO ₂	NO ₂	Cl	NO ₂
Cl	Cl	OMe	F	H	OMe	Me	OMe	OMe	NO ₂	Cl	OMe
Me	Br	Me	Cl	H	Me	Br	NO ₂	Me	Br	Br	Me
Me	Br	F	Cl	H	F	Br	NO ₂	F	Br	Br	F
Me	Br	Cl	Cl	H	Cl	Br	NO ₂	Cl	Br	Br	Cl
Me	Br	Br	Cl	H	Br	Br	NO ₂	Br	Br	Br	Br
Me	Br	CF ₃	Cl	H	CF ₃	Br	NO ₂	CF ₃	Br	Br	CF ₃
Me	Br	NO ₂	Cl	H	NO ₂	Br	NO ₂	NO ₂	Br	Br	NO ₂
Me	Br	OMe	Cl	H	OMe	Br	NO ₂	OMe	Br	Br	OMe
F	Br	Me	CF ₃	H	Me	CF ₃	NO ₂	Me	CF ₃	Br	Me
F	Br	F	CF ₃	H	F	CF ₃	NO ₂	F	CF ₃	Br	F
F	Br	Cl	CF ₃	H	Cl	CF ₃	NO ₂	Cl	CF ₃	Br	Cl
F	Br	Br	CF ₃	H	Br	CF ₃	NO ₂	Br	CF ₃	Br	Br
F	Br	CF ₃	CF ₃	H	CF ₃	CF ₃	NO ₂	CF ₃	CF ₃	Br	CF ₃
F	Br	NO ₂	CF ₃	H	NO ₂	CF ₃	NO ₂	NO ₂	CF ₃	Br	NO ₂
F	Br	OMe	CF ₃	H	OMe	CF ₃	NO ₂	OMe	CF ₃	Br	OMe
Cl	Br	Me	NO ₂	H	Me	Cl	CF ₃	Me	NO ₂	Br	Me
Cl	Br	F	NO ₂	H	F	Cl	CF ₃	F	NO ₂	Br	F
Cl	Br	Cl	NO ₂	H	Cl	Cl	CF ₃	Cl	NO ₂	Br	Cl
Cl	Br	Br	NO ₂	H	Br	Cl	CF ₃	Br	NO ₂	Br	Br
Cl	Br	CF ₃	NO ₂	H	CF ₃	Cl	CF ₃	CF ₃	NO ₂	Br	CF ₃
Cl	Br	NO ₂	NO ₂	H	NO ₂	Cl	CF ₃	NO ₂	NO ₂	Br	NO ₂
Cl	Br	OMe	NO ₂	H	OMe	Cl	CF ₃	OMe	NO ₂	Br	OMe
Me	CF ₃	Me	Cl	OMe	Me	NO ₂	OMe	Me	Br	CF ₃	Me
Me	CF ₃	F	Cl	OMe	F	NO ₂	OMe	F	Br	CF ₃	F
Me	CF ₃	Cl	Cl	OMe	Cl	NO ₂	OMe	Cl	Br	CF ₃	Cl
Me	CF ₃	Br	Cl	OMe	Br	NO ₂	OMe	Br	Br	CF ₃	Br
Me	CF ₃	CF ₃	Cl	OMe	CF ₃	NO ₂	OMe	CF ₃	Br	CF ₃	CF ₃
Me	CF ₃	NO ₂	Cl	OMe	NO ₂	NO ₂	OMe	NO ₂	Br	CF ₃	NO ₂
Me	CF ₃	OMe	Cl	OMe	OMe	NO ₂	OMe	OMe	Br	CF ₃	OMe

T	U	V	T	U	V	T	U	V	T	U	V
F	CF ₃	Me	Me	H	Me	NO ₂	CF ₃	Me	CF ₃	CF ₃	Me
F	CF ₃	F	Me	H	F	NO ₂	CF ₃	F	CF ₃	CF ₃	F
F	CF ₃	Cl	Me	H	Cl	NO ₂	CF ₃	Cl	CF ₃	CF ₃	Cl
F	CF ₃	Br	Me	H	Br	NO ₂	CF ₃	Br	CF ₃	CF ₃	Br
F	CF ₃	CF ₃	Me	H	CF ₃	NO ₂	CF ₃				
F	CF ₃	NO ₂	Me	H	NO ₂	NO ₂	CF ₃	NO ₂	CF ₃	CF ₃	NO ₂
F	CF ₃	OMe	Me	H	OMe	NO ₂	CF ₃	OMe	CF ₃	CF ₃	OMe

Table 2



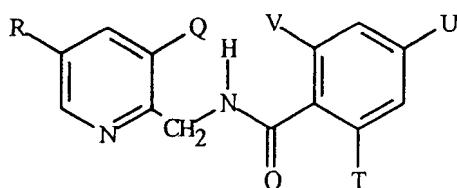
T	U	V	T	U	V	T	U	V	T	U	V
Me	Me	Me	OMe	Me	Me	Cl	NO ₂	Me	Br	Me	Me
Me	Me	F	OMe	Me	F	Cl	NO ₂	F	Br	Me	F
Me	Me	Cl	OMe	Me	Cl	Cl	NO ₂	Cl	Br	Me	Cl
Me	Me	Br	OMe	Me	Br	Cl	NO ₂	Br	Br	Me	Br
Me	Me	CF ₃	OMe	Me	CF ₃	Cl	NO ₂	CF ₃	Br	Me	CF ₃
Me	Me	NO ₂	OMe	Me	NO ₂	Cl	NO ₂	NO ₂	Br	Me	NO ₂
Me	Me	OMe	OMe	Me	OMe	Cl	NO ₂	OMe	Br	Me	OMe
F	Me	Me	OMe	F	Me	CF ₃	OMe	Me	CF ₃	Me	Me
F	Me	F	OMe	F	F	CF ₃	OMe	F	CF ₃	Me	F
F	Me	Cl	OMe	F	Cl	CF ₃	OMe	Cl	CF ₃	Me	Cl
F	Me	Br	OMe	F	Br	CF ₃	OMe	Br	CF ₃	Me	Br
F	Me	CF ₃	OMe	F	CF ₃	CF ₃	OMe	CF ₃	CF ₃	Me	CF ₃
F	Me	NO ₂	OMe	F	NO ₂	F	OMe	Me	CF ₃	Me	NO ₂
F	Me	OMe	OMe	F	OMe	F	OMe	F	CF ₃	Me	OMe
Cl	Me	Me	OMe	Cl	Me	F	OMe	Cl	NO ₂	Me	Me
Cl	Me	F	OMe	Cl	F	F	OMe	Br	NO ₂	Me	F
Cl	Me	Cl	OMe	Cl	Cl	F	OMe	CF ₃	NO ₂	Me	Cl
Cl	Me	Br	OMe	Cl	Br	F	OMe	NO ₂	NO ₂	Me	Br
Cl	Me	CF ₃	OMe	Cl	CF ₃	F	OMe	OMe	NO ₂	Me	CF ₃
Cl	Me	NO ₂	OMe	Cl	NO ₂	CF ₃	OMe	NO ₂	NO ₂	Me	NO ₂
Cl	Me	OMe	OMe	Cl	OMe	CF ₃	OMe	OMe	NO ₂	Me	OMe

T	U	V	T	U	V	T	U	V	T	U	V
Me	F	Me	OMe	H	Me	Br	OMe	NO ₂	Br	F	Me
Me	F	F	OMe	H	F	Br	OMe	OMe	Br	F	F
Me	F	Cl	OMe	H	Cl	NO ₂	NO ₂	Me	Br	F	Cl
Me	F	Br	OMe	H	OMe	NO ₂	NO ₂	F	Br	F	Br
Me	F	CF ₃	OMe	OMe	CF ₃	NO ₂	NO ₂	Cl	Br	F	CF ₃
Me	F	NO ₂	OMe	OMe	NO ₂	NO ₂	NO ₂	Br	Br	F	NO ₂
Me	F	OMe	OMe	OMe	OMe	NO ₂	NO ₂	CF ₃	Br	F	OMe
F	F	Me	OMe	Br	Me	NO ₂	NO ₂	NO ₂	CF ₃	F	Me
F	F	F	OMe	Br	F	NO ₂	NO ₂	OMe	CF ₃	F	F
F	F	Cl	OMe	Br	Cl	Br	OMe	Me	CF ₃	F	Cl
F	F	Br	OMe	Br	Br	Br	OMe	F	CF ₃	F	Br
F	F	CF ₃	OMe	Br	CF ₃	Br	OMe	Cl	CF ₃	F	CF ₃
F	F	NO ₂	OMe	Br	NO ₂	Br	OMe	Br	CF ₃	F	NO ₂
F	F	OMe	OMe	Br	OMe	Br	OMe	CF ₃	CF ₃	F	OMe
Cl	F	Me	OMe	CF ₃	Me	Me	NO ₂	Me	NO ₂	F	Me
Cl	F	F	OMe	CF ₃	F	Me	NO ₂	F	NO ₂	F	F
Cl	F	Cl	OMe	CF ₃	Cl	Me	NO ₂	Cl	NO ₂	F	Cl
Cl	F	Br	OMe	CF ₃	Br	Me	NO ₂	Br	NO ₂	F	Br
Cl	F	CF ₃	OMe	CF ₃	CF ₃	Me	NO ₂	CF ₃	NO ₂	F	CF ₃
Cl	F	NO ₂	OMe	CF ₃	NO ₂	Me	NO ₂	NO ₂	NO ₂	F	NO ₂
Cl	F	OMe	OMe	CF ₃	OMe	Me	NO ₂	OMe	NO ₂	F	OMe
Me	Cl	Me	OMe	NO ₂	Me	F	NO ₂	Me	Br	Cl	Me
Me	Cl	F	OMe	NO ₂	F	F	NO ₂	F	Br	Cl	F
Me	Cl	Cl	OMe	NO ₂	Cl	F	NO ₂	Cl	Br	Cl	Cl
Me	Cl	Br	OMe	NO ₂	Br	F	NO ₂	Br	Br	Cl	Br
Me	Cl	CF ₃	OMe	NO ₂	CF ₃	F	NO ₂	CF ₃	Br	Cl	CF ₃
Me	Cl	NO ₂	OMe	NO ₂	NO ₂	F	NO ₂	NO ₂	Br	Cl	NO ₂
Me	Cl	OMe	OMe	NO ₂	OMe	F	NO ₂	OMe	Br	Cl	OMe
F	Cl	Me	OMe	H	Br	Br	H	Me	CF ₃	Cl	Me
F	Cl	F	OMe	H	CF ₃	Br	H	F	CF ₃	Cl	F
F	Cl	Cl	OMe	H	NO ₂	Br	H	Cl	CF ₃	Cl	Cl
F	Cl	Br	OMe	OMe	Me	Br	H	Br	CF ₃	Cl	Br
F	Cl	CF ₃	OMe	OMe	F	Br	H	CF ₃	CF ₃	Cl	CF ₃
F	Cl	NO ₂	OMe	OMe	Cl	Br	H	NO ₂	CF ₃	Cl	NO ₂
F	Cl	OMe	OMe	OMe	Br	Br	H	OMe	CF ₃	Cl	OMe
Cl	Cl	Me	F	H	Me	Me	OMe	Me	NO ₂	Cl	Me
Cl	Cl	F	F	H	F	Me	OMe	F	NO ₂	Cl	F

T	U	V	T	U	V	T	U	V	T	U	V
Cl	Cl	Cl	F	H	Cl	Me	OMe	Cl	NO ₂	Cl	Cl
Cl	Cl	Br	F	H	Br	Me	OMe	Br	NO ₂	Cl	Br
Cl	Cl	CF ₃	F	H	CF ₃	Me	OMe	CF ₃	NO ₂	Cl	CF ₃
Cl	Cl	NO ₂	F	H	NO ₂	Me	OMe	NO ₂	NO ₂	Cl	NO ₂
Cl	Cl	OMe	F	H	OMe	Me	OMe	OMe	NO ₂	Cl	OMe
Me	Br	Me	Cl	H	Me	Br	NO ₂	Me	Br	Br	Me
Me	Br	F	Cl	H	F	Br	NO ₂	F	Br	Br	F
Me	Br	Cl	Cl	H	Cl	Br	NO ₂	Cl	Br	Br	Cl
Me	Br	Br	Cl	H	Br	Br	NO ₂	Br	Br	Br	Br
Me	Br	CF ₃	Cl	H	CF ₃	Br	NO ₂	CF ₃	Br	Br	CF ₃
Me	Br	NO ₂	Cl	H	NO ₂	Br	NO ₂	NO ₂	Br	Br	NO ₂
Me	Br	OMe	Cl	H	OMe	Br	NO ₂	OMe	Br	Br	OMe
F	Br	Me	CF ₃	H	Me	CF ₃	NO ₂	Me	CF ₃	Br	Me
F	Br	F	CF ₃	H	F	CF ₃	NO ₂	F	CF ₃	Br	F
F	Br	Cl	CF ₃	H	Cl	CF ₃	NO ₂	Cl	CF ₃	Br	Cl
F	Br	Br	CF ₃	H	Br	CF ₃	NO ₂	Br	CF ₃	Br	Br
F	Br	CF ₃	CF ₃	H	CF ₃	CF ₃	NO ₂	CF ₃	CF ₃	Br	CF ₃
F	Br	NO ₂	CF ₃	H	NO ₂	CF ₃	NO ₂	NO ₂	CF ₃	Br	NO ₂
F	Br	OMe	CF ₃	H	OMe	CF ₃	NO ₂	OMe	CF ₃	Br	OMe
Cl	Br	Me	NO ₂	H	Me	Cl	CF ₃	Me	NO ₂	Br	Me
Cl	Br	F	NO ₂	H	F	Cl	CF ₃	F	NO ₂	Br	F
Cl	Br	Cl	NO ₂	H	Cl	Cl	CF ₃	Cl	NO ₂	Br	Cl
Cl	Br	Br	NO ₂	H	Br	Cl	CF ₃	Br	NO ₂	Br	Br
Cl	Br	CF ₃	NO ₂	H	CF ₃	Cl	CF ₃	CF ₃	NO ₂	Br	CF ₃
Cl	Br	NO ₂	NO ₂	H	NO ₂	Cl	CF ₃	NO ₂	NO ₂	Br	NO ₂
Cl	Br	OMe	NO ₂	H	OMe	Cl	CF ₃	OMe	NO ₂	Br	OMe
Me	CF ₃	Me	Cl	OMe	Me	NO ₂	OMe	Me	Br	CF ₃	Me
Me	CF ₃	F	Cl	OMe	F	NO ₂	OMe	F	Br	CF ₃	F
Me	CF ₃	Cl	Cl	OMe	Cl	NO ₂	OMe	Cl	Br	CF ₃	Cl
Me	CF ₃	Br	Cl	OMe	Br	NO ₂	OMe	Br	Br	CF ₃	Br
Me	CF ₃	CF ₃	Cl	OMe	CF ₃	NO ₂	OMe	CF ₃	Br	CF ₃	CF ₃
Me	CF ₃	NO ₂	Cl	OMe	NO ₂	NO ₂	OMe	NO ₂	Br	CF ₃	NO ₂
Me	CF ₃	OMe	Cl	OMe	OMe	NO ₂	OMe	OMe	Br	CF ₃	OMe
F	CF ₃	Me	Me	H	Me	NO ₂	CF ₃	Me	CF ₃	CF ₃	Me
F	CF ₃	F	Me	H	F	NO ₂	CF ₃	F	CF ₃	CF ₃	F
F	CF ₃	Cl	Me	H	Cl	NO ₂	CF ₃	Cl	CF ₃	CF ₃	Cl
F	CF ₃	Br	Me	H	Br	NO ₂	CF ₃	Br	CF ₃	CF ₃	Br

T	U	V	T	U	V	T	U	V	T	U	V
F	CF ₃	CF ₃	Me	H	CF ₃	NO ₂	CF ₃				
F	CF ₃	NO ₂	Me	H	NO ₂	NO ₂	CF ₃	NO ₂	CF ₃	CF ₃	NO ₂
F	CF ₃	OMe	Me	H	OMe	NO ₂	CF ₃	OMe	CF ₃	CF ₃	OMe

Table 3



T and V are both Cl and U is H

Q	R	Q	R	Q	R	Q	R
Cl	Cl	Cl	OCH ₂ CF ₃	Br	Cl	Br	OCH ₂ CF ₃
Cl	Br	Cl	OCF ₂ CF ₂ H	Br	Br	Br	OCF ₂ CF ₂ H
Cl	OCF ₃	Cl	OCHFCF ₃	Br	OCF ₃	Br	OCHFCF ₃
Cl	OCHF ₂	Cl	SCH ₂ CF ₃	Br	OCHF ₂	Br	SCH ₂ CF ₃
Cl	SCF ₃	Cl	SCF ₂ CF ₃	Br	SCF ₃	Br	SCF ₂ CF ₃
Cl	SCHF ₂	Cl	SCF ₂ CF ₂ H	Br	SCHF ₂	Br	SCF ₂ CF ₂ H
Cl	SOCF ₃	Cl	SOCH ₂ CF ₃	Br	SOCF ₃	Br	SOCH ₂ CF ₃
Cl	SOCHF ₂	Cl	SOCF ₂ CF ₃	Br	SOCHF ₂	Br	SOCF ₂ CF ₃
Cl	SO ₂ CF ₃	Cl	SOCF ₂ CF ₂ H	Br	SO ₂ CF ₃	Br	SOCF ₂ CF ₂ H
Cl	SO ₂ CHF ₂	Cl	SOCHFCF ₃	Br	SO ₂ CHF ₂	Br	SOCHFCF ₃
Cl	CN	Cl	SO ₂ CH ₂ CF ₃	Br	CN	Br	SO ₂ CH ₂ CF ₃
Cl	I	Cl	SO ₂ CF ₂ CF ₃	Br	I	Br	SO ₂ CF ₂ CF ₃
Cl	OCH ₂ F	Cl	SO ₂ CF ₂ CF ₂ H	Br	OCH ₂ F	Br	SO ₂ CF ₂ CF ₂ H
Cl	SCH ₂ F	Cl	SO ₂ CHFCF ₃	Br	SCH ₂ F	Br	SO ₂ CHFCF ₃
Cl	Et	Cl	OCF ₂ CF ₃	Br	Et	Br	OCF ₂ CF ₃
Cl	OCF ₂ Cl	Cl	SCHFCF ₃	Br	OCF ₂ Cl	Br	SCHFCF ₃

T and V are both Cl and U is CH₃

Q	R	Q	R	Q	R	Q	R
Cl	Cl	Cl	OCH ₂ CF ₃	Br	Cl	Br	OCH ₂ CF ₃
Cl	Br	Cl	OCF ₂ CF ₂ H	Br	Br	Br	OCF ₂ CF ₂ H
Cl	OCF ₃	Cl	OCHFCF ₃	Br	OCF ₃	Br	OCHFCF ₃
Cl	OCHF ₂	Cl	SCH ₂ CF ₃	Br	OCHF ₂	Br	SCH ₂ CF ₃
Cl	SCF ₃	Cl	SCF ₂ CF ₃	Br	SCF ₃	Br	SCF ₂ CF ₃

T and V are both Cl and U is CH₃

Q	R	Q	R	Q	R	Q	R
Cl	SCHF ₂	Cl	SCF ₂ CF ₂ H	Br	SCHF ₂	Br	SCF ₂ CF ₂ H
Cl	SOCF ₃	Cl	SOCH ₂ CF ₃	Br	SOCF ₃	Br	SOCH ₂ CF ₃
Cl	SOCHF ₂	Cl	SOCF ₂ CF ₃	Br	SOCHF ₂	Br	SOCF ₂ CF ₃
Cl	SO ₂ CF ₃	Cl	SOCF ₂ CF ₂ H	Br	SO ₂ CF ₃	Br	SOCF ₂ CF ₂ H
Cl	SO ₂ CHF ₂	Cl	SOCHFCF ₃	Br	SO ₂ CHF ₂	Br	SOCHFCF ₃
Cl	CN	Cl	SO ₂ CH ₂ CF ₃	Br	CN	Br	SO ₂ CH ₂ CF ₃
Cl	I	Cl	SO ₂ CF ₂ CF ₃	Br	I	Br	SO ₂ CF ₂ CF ₃
Cl	OCH ₂ F	Cl	SO ₂ CF ₂ CF ₂ H	Br	OCH ₂ F	Br	SO ₂ CF ₂ CF ₂ H
Cl	SCH ₂ F	Cl	SO ₂ CHFCF ₃	Br	SCH ₂ F	Br	SO ₂ CHFCF ₃
Cl	Et	Cl	OCF ₂ CF ₃	Br	Et	Br	OCF ₂ CF ₃
Cl	OCF ₂ Cl	Cl	SCHFCF ₃	Br	OCF ₂ Cl	Br	SCHFCF ₃

T is Cl and V are both Me

Q	R	Q	R	Q	R	Q	R
Cl	Cl	Cl	OCH ₂ CF ₃	Br	Cl	Br	OCH ₂ CF ₃
Cl	Br	Cl	OCF ₂ CF ₂ H	Br	Br	Br	OCF ₂ CF ₂ H
Cl	OCF ₃	Cl	OCHFCF ₃	Br	OCF ₃	Br	OCHFCF ₃
Cl	OCHF ₂	Cl	SCH ₂ CF ₃	Br	OCHF ₂	Br	SCH ₂ CF ₃
Cl	SCF ₃	Cl	SCF ₂ CF ₃	Br	SCF ₃	Br	SCF ₂ CF ₃
Cl	SCHF ₂	Cl	SCF ₂ CF ₂ H	Br	SCHF ₂	Br	SCF ₂ CF ₂ H
Cl	SOCF ₃	Cl	SOCH ₂ CF ₃	Br	SOCF ₃	Br	SOCH ₂ CF ₃
Cl	SOCHF ₂	Cl	SOCF ₂ CF ₃	Br	SOCHF ₂	Br	SOCF ₂ CF ₃
Cl	SO ₂ CF ₃	Cl	SOCF ₂ CF ₂ H	Br	SO ₂ CF ₃	Br	SOCF ₂ CF ₂ H
Cl	SO ₂ CHF ₂	Cl	SOCHFCF ₃	Br	SO ₂ CHF ₂	Br	SOCHFCF ₃
Cl	CN	Cl	SO ₂ CH ₂ CF ₃	Br	CN	Br	SO ₂ CH ₂ CF ₃
Cl	I	Cl	SO ₂ CF ₂ CF ₃	Br	I	Br	SO ₂ CF ₂ CF ₃
Cl	OCH ₂ F	Cl	SO ₂ CF ₂ CF ₂ H	Br	OCH ₂ F	Br	SO ₂ CF ₂ CF ₂ H
Cl	SCH ₂ F	Cl	SO ₂ CHFCF ₃	Br	SCH ₂ F	Br	SO ₂ CHFCF ₃
Cl	Et	Cl	OCF ₂ CF ₃	Br	Et	Br	OCF ₂ CF ₃
Cl	OCF ₂ Cl	Cl	SCHFCF ₃	Br	OCF ₂ Cl	Br	SCHFCF ₃

T is Cl, V is I and U is H

Q	R	Q	R	Q	R	Q	R
Cl	Cl	Cl	OCH ₂ CF ₃	Br	Cl	Br	OCH ₂ CF ₃
Cl	Br	Cl	OCF ₂ CF ₂ H	Br	Br	Br	OCF ₂ CF ₂ H
Cl	OCF ₃	Cl	OCHFCF ₃	Br	OCF ₃	Br	OCHFCF ₃

T is Cl, V is I and U is H

Q	R	Q	R	Q	R	Q	R
Cl	OCHF ₂	Cl	SCH ₂ CF ₃	Br	OCHF ₂	Br	SCH ₂ CF ₃
Cl	SCF ₃	Cl	SCF ₂ CF ₃	Br	SCF ₃	Br	SCF ₂ CF ₃
Cl	SCHF ₂	Cl	SCF ₂ CF ₂ H	Br	SCHF ₂	Br	SCF ₂ CF ₂ H
Cl	SOCF ₃	Cl	SOCH ₂ CF ₃	Br	SOCF ₃	Br	SOCH ₂ CF ₃
Cl	SOCHF ₂	Cl	SOCF ₂ CF ₃	Br	SOCHF ₂	Br	SOCF ₂ CF ₃
Cl	SO ₂ CF ₃	Cl	SOCF ₂ CF ₂ H	Br	SO ₂ CF ₃	Br	SOCF ₂ CF ₂ H
Cl	SO ₂ CHF ₂	Cl	SOCHFCF ₃	Br	SO ₂ CHF ₂	Br	SOCHFCF ₃
Cl	CN	Cl	SO ₂ CH ₂ CF ₃	Br	CN	Br	SO ₂ CH ₂ CF ₃
Cl	I	Cl	SO ₂ CF ₂ CF ₃	Br	I	Br	SO ₂ CF ₂ CF ₃
Cl	OCH ₂ F	Cl	SO ₂ CF ₂ CF ₂ H	Br	OCH ₂ F	Br	SO ₂ CF ₂ CF ₂ H
Cl	SCH ₂ F	Cl	SO ₂ CHFCF ₃	Br	SCH ₂ F	Br	SO ₂ CHFCF ₃
Cl	Et	Cl	OCF ₂ CF ₃	Br	Et	Br	OCF ₂ CF ₃
Cl	OCF ₂ Cl	Cl	SCHFCF ₃	Br	OCF ₂ Cl	Br	SCHFCF ₃

T is Cl, V is I and U is Me

Q	R	Q	R	Q	R	Q	R
Cl	Cl	Cl	OCH ₂ CF ₃	Br	Cl	Br	OCH ₂ CF ₃
Cl	Br	Cl	OCF ₂ CF ₂ H	Br	Br	Br	OCF ₂ CF ₂ H
Cl	OCF ₃	Cl	OCHFCF ₃	Br	OCF ₃	Br	OCHFCF ₃
Cl	SCHF ₂	Cl	SCH ₂ CF ₃	Br	OCHF ₂	Br	SCH ₂ CF ₃
Cl	SCF ₃	Cl	SCF ₂ CF ₃	Br	SCF ₃	Br	SCF ₂ CF ₃
Cl	SCHF ₂	Cl	SCF ₂ CF ₂ H	Br	SCHF ₂	Br	SCF ₂ CF ₂ H
Cl	SOCF ₃	Cl	SOCH ₂ CF ₃	Br	SOCF ₃	Br	SOCH ₂ CF ₃
Cl	SOCHF ₂	Cl	SOCF ₂ CF ₃	Br	SOCHF ₂	Br	SOCF ₂ CF ₃
Cl	SO ₂ CF ₃	Cl	SOCF ₂ CF ₂ H	Br	SO ₂ CF ₃	Br	SOCF ₂ CF ₂ H
Cl	SO ₂ CHF ₂	Cl	SOCHFCF ₃	Br	SO ₂ CHF ₂	Br	SOCHFCF ₃
Cl	CN	Cl	SO ₂ CH ₂ CF ₃	Br	CN	Br	SO ₂ CH ₂ CF ₃
Cl	I	Cl	SO ₂ CF ₂ CF ₃	Br	I	Br	SO ₂ CF ₂ CF ₃
Cl	OCH ₂ F	Cl	SO ₂ CF ₂ CF ₂ H	Br	OCH ₂ F	Br	SO ₂ CF ₂ CF ₂ H
Cl	SCH ₂ F	Cl	SO ₂ CHFCF ₃	Br	SCH ₂ F	Br	SO ₂ CHFCF ₃
Cl	Et	Cl	OCF ₂ CF ₃	Br	Et	Br	OCF ₂ CF ₃
Cl	OCF ₂ Cl	Cl	SCHFCF ₃	Br	OCF ₂ Cl	Br	SCHFCF ₃

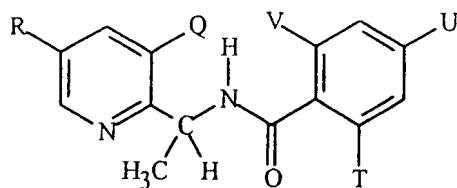
T is F, V is I and U is H

Q	R	Q	R	Q	R	Q	R
Cl	Cl	Cl	OCH ₂ CF ₃	Br	Cl	Br	OCH ₂ CF ₃
Cl	Br	Cl	OCF ₂ CF ₂ H	Br	Br	Br	OCF ₂ CF ₂ H
Cl	OCF ₃	Cl	OCHFCF ₃	Br	OCF ₃	Br	OCHFCF ₃
Cl	OCHF ₂	Cl	SCH ₂ CF ₃	Br	OCHF ₂	Br	SCH ₂ CF ₃
Cl	SCF ₃	Cl	SCF ₂ CF ₃	Br	SCF ₃	Br	SCF ₂ CF ₃
Cl	SCHF ₂	Cl	SCF ₂ CF ₂ H	Br	SCHF ₂	Br	SCF ₂ CF ₂ H
Cl	SOCF ₃	Cl	SOCH ₂ CF ₃	Br	SOCF ₃	Br	SOCH ₂ CF ₃
Cl	SOCHF ₂	Cl	SOCF ₂ CF ₃	Br	SOCHF ₂	Br	SOCF ₂ CF ₃
Cl	SO ₂ CF ₃	Cl	SOCF ₂ CF ₂ H	Br	SO ₂ CF ₃	Br	SOCF ₂ CF ₂ H
Cl	SO ₂ CHF ₂	Cl	SOCHFCF ₃	Br	SO ₂ CHF ₂	Br	SOCHFCF ₃
Cl	CN	Cl	SO ₂ CH ₂ CF ₃	Br	CN	Br	SO ₂ CH ₂ CF ₃
Cl	I	Cl	SO ₂ CF ₂ CF ₃	Br	I	Br	SO ₂ CF ₂ CF ₃
Cl	OCH ₂ F	Cl	SO ₂ CF ₂ CF ₂ H	Br	OCH ₂ F	Br	SO ₂ CF ₂ CF ₂ H
Cl	SCH ₂ F	Cl	SO ₂ CHFCF ₃	Br	SCH ₂ F	Br	SO ₂ CHFCF ₃
Cl	Et	Cl	OCF ₂ CF ₃	Br	Et	Br	OCF ₂ CF ₃
Cl	OCF ₂ Cl	Cl	SCHFCF ₃	Br	OCF ₂ Cl	Br	SCHFCF ₃

T is F, V is I and U is Me

Q	R	Q	R	Q	R	Q	R
Cl	Cl	Cl	OCH ₂ CF ₃	Br	Cl	Br	OCH ₂ CF ₃
Cl	Br	Cl	OCF ₂ CF ₂ H	Br	Br	Br	OCF ₂ CF ₂ H
Cl	OCF ₃	Cl	OCHFCF ₃	Br	OCF ₃	Br	OCHFCF ₃
Cl	OCHF ₂	Cl	SCH ₂ CF ₃	Br	OCHF ₂	Br	SCH ₂ CF ₃
Cl	SCF ₃	Cl	SCF ₂ CF ₃	Br	SCF ₃	Br	SCF ₂ CF ₃
Cl	SCHF ₂	Cl	SCF ₂ CF ₂ H	Br	SCHF ₂	Br	SCF ₂ CF ₂ H
Cl	SOCF ₃	Cl	SOCH ₂ CF ₃	Br	SOCF ₃	Br	SOCH ₂ CF ₃
Cl	SOCHF ₂	Cl	SOCF ₂ CF ₃	Br	SOCHF ₂	Br	SOCF ₂ CF ₃
Cl	SO ₂ CF ₃	Cl	SOCF ₂ CF ₂ H	Br	SO ₂ CF ₃	Br	SOCF ₂ CF ₂ H
Cl	SO ₂ CHF ₂	Cl	SOCHFCF ₃	Br	SO ₂ CHF ₂	Br	SOCHFCF ₃
Cl	CN	Cl	SO ₂ CH ₂ CF ₃	Br	CN	Br	SO ₂ CH ₂ CF ₃
Cl	I	Cl	SO ₂ CF ₂ CF ₃	Br	I	Br	SO ₂ CF ₂ CF ₃
Cl	OCH ₂ F	Cl	SO ₂ CF ₂ CF ₂ H	Br	OCH ₂ F	Br	SO ₂ CF ₂ CF ₂ H
Cl	SCH ₂ F	Cl	SO ₂ CHFCF ₃	Br	SCH ₂ F	Br	SO ₂ CHFCF ₃
Cl	Et	Cl	OCF ₂ CF ₃	Br	Et	Br	OCF ₂ CF ₃
Cl	OCF ₂ Cl	Cl	SCHFCF ₃	Br	OCF ₂ Cl	Br	SCHFCF ₃

Table 4



T and V are both Cl and U is H

Q	R	Q	R	Q	R	Q	R
Cl	Cl	Cl	OCH ₂ CF ₃	Br	Cl	Br	OCH ₂ CF ₃
Cl	Br	Cl	OCF ₂ CF ₂ H	Br	Br	Br	OCF ₂ CF ₂ H
Cl	OCF ₃	Cl	OCHFCF ₃	Br	OCF ₃	Br	OCHFCF ₃
Cl	OCHF ₂	Cl	SCH ₂ CF ₃	Br	OCHF ₂	Br	SCH ₂ CF ₃
Cl	SCF ₃	Cl	SCF ₂ CF ₃	Br	SCF ₃	Br	SCF ₂ CF ₃
Cl	SCHF ₂	Cl	SCF ₂ CF ₂ H	Br	SCHF ₂	Br	SCF ₂ CF ₂ H
Cl	SOCF ₃	Cl	SOCH ₂ CF ₃	Br	SOCF ₃	Br	SOCH ₂ CF ₃
Cl	SOCHF ₂	Cl	SOCF ₂ CF ₃	Br	SOCHF ₂	Br	SOCF ₂ CF ₃
Cl	SO ₂ CF ₃	Cl	SOCF ₂ CF ₂ H	Br	SO ₂ CF ₃	Br	SOCF ₂ CF ₂ H
Cl	SO ₂ CHF ₂	Cl	SOCHFCF ₃	Br	SO ₂ CHF ₂	Br	SOCHFCF ₃
Cl	CN	Cl	SO ₂ CH ₂ CF ₃	Br	CN	Br	SO ₂ CH ₂ CF ₃
Cl	I	Cl	SO ₂ CF ₂ CF ₃	Br	I	Br	SO ₂ CF ₂ CF ₃
Cl	OCH ₂ F	Cl	SO ₂ CF ₂ CF ₂ H	Br	OCH ₂ F	Br	SO ₂ CF ₂ CF ₂ H
Cl	SCH ₂ F	Cl	SO ₂ CHFCF ₃	Br	SCH ₂ F	Br	SO ₂ CHFCF ₃
Cl	Et	Cl	OCF ₂ CF ₃	Br	Et	Br	OCF ₂ CF ₃
Cl	OCF ₂ Cl	Cl	SCHFCF ₃	Br	OCF ₂ Cl	Br	SCHFCF ₃

T and V are both Cl and U is CH₃

Q	R	Q	R	Q	R	Q	R
Cl	Cl	Cl	OCH ₂ CF ₃	Br	Cl	Br	OCH ₂ CF ₃
Cl	Br	Cl	OCF ₂ CF ₂ H	Br	Br	Br	OCF ₂ CF ₂ H
Cl	OCF ₃	Cl	OCHFCF ₃	Br	OCF ₃	Br	OCHFCF ₃
Cl	OCHF ₂	Cl	SCH ₂ CF ₃	Br	OCHF ₂	Br	SCH ₂ CF ₃
Cl	SCF ₃	Cl	SCF ₂ CF ₃	Br	SCF ₃	Br	SCF ₂ CF ₃
Cl	SCHF ₂	Cl	SCF ₂ CF ₂ H	Br	SCHF ₂	Br	SCF ₂ CF ₂ H
Cl	SOCF ₃	Cl	SOCH ₂ CF ₃	Br	SOCF ₃	Br	SOCH ₂ CF ₃
Cl	SOCHF ₂	Cl	SOCF ₂ CF ₃	Br	SOCHF ₂	Br	SOCF ₂ CF ₃
Cl	SO ₂ CF ₃	Cl	SOCF ₂ CF ₂ H	Br	SO ₂ CF ₃	Br	SOCF ₂ CF ₂ H
Cl	SO ₂ CHF ₂	Cl	SOCHFCF ₃	Br	SO ₂ CHF ₂	Br	SOCHFCF ₃

T and V are both Cl and U is CH₃

Q	R	Q	R	Q	R	Q	R
Cl	CN	Cl	SO ₂ CH ₂ CF ₃	Br	CN	Br	SO ₂ CH ₂ CF ₃
Cl	I	Cl	SO ₂ CF ₂ CF ₃	Br	I	Br	SO ₂ CF ₂ CF ₃
Cl	OCH ₂ F	Cl	SO ₂ CF ₂ CF ₂ H	Br	OCH ₂ F	Br	SO ₂ CF ₂ CF ₂ H
Cl	SCH ₂ F	Cl	SO ₂ CHFCF ₃	Br	SCH ₂ F	Br	SO ₂ CHFCF ₃
Cl	Et	Cl	OCF ₂ CF ₃	Br	Et	Br	OCF ₂ CF ₃
Cl	OCF ₂ Cl	Cl	SCHFCF ₃	Br	OCF ₂ Cl	Br	SCHFCF ₃

T is Cl and V and U are both Me

Q	R	Q	R	Q	R	Q	R
Cl	Cl	Cl	OCH ₂ CF ₃	Br	Cl	Br	OCH ₂ CF ₃
Cl	Br	Cl	OCF ₂ CF ₂ H	Br	Br	Br	OCF ₂ CF ₂ H
Cl	OCF ₃	Cl	OCHFCF ₃	Br	OCF ₃	Br	OCHFCF ₃
Cl	OCHF ₂	Cl	SCH ₂ CF ₃	Br	OCHF ₂	Br	SCH ₂ CF ₃
Cl	SCF ₃	Cl	SCF ₂ CF ₃	Br	SCF ₃	Br	SCF ₂ CF ₃
Cl	SCHF ₂	Cl	SCF ₂ CF ₂ H	Br	SCHF ₂	Br	SCF ₂ CF ₂ H
Cl	SOCF ₃	Cl	SOCH ₂ CF ₃	Br	SOCF ₃	Br	SOCH ₂ CF ₃
Cl	SOCHF ₂	Cl	SOCF ₂ CF ₃	Br	SOCHF ₂	Br	SOCF ₂ CF ₃
Cl	SO ₂ CF ₃	Cl	SOCF ₂ CF ₂ H	Br	SO ₂ CF ₃	Br	SOCF ₂ CF ₂ H
Cl	SO ₂ CHF ₂	Cl	SOCHFCF ₃	Br	SO ₂ CHF ₂	Br	SOCHFCF ₃
Cl	CN	Cl	SO ₂ CH ₂ CF ₃	Br	CN	Br	SO ₂ CH ₂ CF ₃
Cl	I	Cl	SO ₂ CF ₂ CF ₃	Br	I	Br	SO ₂ CF ₂ CF ₃
Cl	OCH ₂ F	Cl	SO ₂ CF ₂ CF ₂ H	Br	OCH ₂ F	Br	SO ₂ CF ₂ CF ₂ H
Cl	SCH ₂ F	Cl	SO ₂ CHFCF ₃	Br	SCH ₂ F	Br	SO ₂ CHFCF ₃
Cl	Et	Cl	OCF ₂ CF ₃	Br	Et	Br	OCF ₂ CF ₃
Cl	OCF ₂ Cl	Cl	SCHFCF ₃	Br	OCF ₂ Cl	Br	SCHFCF ₃

T is Cl, V is I and U is H

Q	R	Q	R	Q	R	Q	R
Cl	Cl	Cl	OCH ₂ CF ₃	Br	Cl	Br	OCH ₂ CF ₃
Cl	Br	Cl	OCF ₂ CF ₂ H	Br	Br	Br	OCF ₂ CF ₂ H
Cl	OCF ₃	Cl	OCHFCF ₃	Br	OCF ₃	Br	OCHFCF ₃
Cl	OCHF ₂	Cl	SCH ₂ CF ₃	Br	OCHF ₂	Br	SCH ₂ CF ₃
Cl	SCF ₃	Cl	SCF ₂ CF ₃	Br	SCF ₃	Br	SCF ₂ CF ₃
Cl	SCHF ₂	Cl	SCF ₂ CF ₂ H	Br	SCHF ₂	Br	SCF ₂ CF ₂ H
Cl	SOCF ₃	Cl	SOCH ₂ CF ₃	Br	SOCF ₃	Br	SOCH ₂ CF ₃
Cl	SOCHF ₂	Cl	SOCF ₂ CF ₃	Br	SOCHF ₂	Br	SOCF ₂ CF ₃

T is Cl, V is I and U is H

Q	R	Q	R	Q	R	Q	R
Cl	SO ₂ CF ₃	Cl	SOClF ₂ CF ₂ H	Br	SO ₂ CF ₃	Br	SOClF ₂ CF ₂ H
Cl	SO ₂ CHF ₂	Cl	SOCHFCF ₃	Br	SO ₂ CHF ₂	Br	SOCHFCF ₃
Cl	CN	Cl	SO ₂ CH ₂ CF ₃	Br	CN	Br	SO ₂ CH ₂ CF ₃
Cl	I	Cl	SO ₂ CF ₂ CF ₃	Br	I	Br	SO ₂ CF ₂ CF ₃
Cl	OCH ₂ F	Cl	SO ₂ CF ₂ CF ₂ H	Br	OCH ₂ F	Br	SO ₂ CF ₂ CF ₂ H
Cl	SCH ₂ F	Cl	SO ₂ CHFCF ₃	Br	SCH ₂ F	Br	SO ₂ CHFCF ₃
Cl	Et	Cl	OCF ₂ CF ₃	Br	Et	Br	OCF ₂ CF ₃
Cl	OCF ₂ Cl	Cl	SCHFCF ₃	Br	OCF ₂ Cl	Br	SCHFCF ₃

T is Cl, V is I and U is Me

Q	R	Q	R	Q	R	Q	R
Cl	Cl	Cl	OCH ₂ CF ₃	Br	Cl	Br	OCH ₂ CF ₃
Cl	Br	Cl	OCF ₂ CF ₂ H	Br	Br	Br	OCF ₂ CF ₂ H
Cl	OCF ₃	Cl	OCHFCF ₃	Br	OCF ₃	Br	OCHFCF ₃
Cl	OCHF ₂	Cl	SCH ₂ CF ₃	Br	OCHF ₂	Br	SCH ₂ CF ₃
Cl	SCF ₃	Cl	SCF ₂ CF ₃	Br	SCF ₃	Br	SCF ₂ CF ₃
Cl	SCHF ₂	Cl	SCF ₂ CF ₂ H	Br	SCHF ₂	Br	SCF ₂ CF ₂ H
Cl	SOClF ₃	Cl	SOCH ₂ CF ₃	Br	SOClF ₃	Br	SOCH ₂ CF ₃
Cl	SOCHF ₂	Cl	SOClF ₂ CF ₃	Br	SOCHF ₂	Br	SOClF ₂ CF ₃
Cl	SO ₂ CF ₃	Cl	SOClF ₂ CF ₂ H	Br	SO ₂ CF ₃	Br	SOClF ₂ CF ₂ H
Cl	SO ₂ CHF ₂	Cl	SOCHFCF ₃	Br	SO ₂ CHF ₂	Br	SOCHFCF ₃
Cl	CN	Cl	SO ₂ CH ₂ CF ₃	Br	CN	Br	SO ₂ CH ₂ CF ₃
Cl	I	Cl	SO ₂ CF ₂ CF ₃	Br	I	Br	SO ₂ CF ₂ CF ₃
Cl	OCH ₂ F	Cl	SO ₂ CF ₂ CF ₂ H	Br	OCH ₂ F	Br	SO ₂ CF ₂ CF ₂ H
Cl	SCH ₂ F	Cl	SO ₂ CHFCF ₃	Br	SCH ₂ F	Br	SO ₂ CHFCF ₃
Cl	Et	Cl	OCF ₂ CF ₃	Br	Et	Br	OCF ₂ CF ₃
Cl	OCF ₂ Cl	Cl	SCHFCF ₃	Br	OCF ₂ Cl	Br	SCHFCF ₃

T is F, V is I and U is H

Q	R	Q	R	Q	R	Q	R
Cl	Cl	Cl	OCH ₂ CF ₃	Br	Cl	Br	OCH ₂ CF ₃
Cl	Br	Cl	OCF ₂ CF ₂ H	Br	Br	Br	OCF ₂ CF ₂ H
Cl	OCF ₃	Cl	OCHFCF ₃	Br	OCF ₃	Br	OCHFCF ₃
Cl	OCHF ₂	Cl	SCH ₂ CF ₃	Br	OCHF ₂	Br	SCH ₂ CF ₃
Cl	SCF ₃	Cl	SCF ₂ CF ₃	Br	SCF ₃	Br	SCF ₂ CF ₃
Cl	SCHF ₂	Cl	SCF ₂ CF ₂ H	Br	SCHF ₂	Br	SCF ₂ CF ₂ H

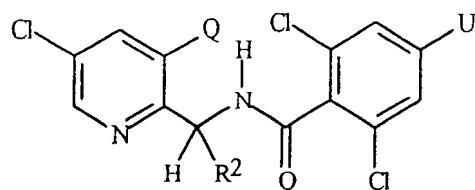
T is F, V is I and U is H

Q	R	Q	R	Q	R	Q	R
Cl	SO ₂ CF ₃	Cl	SOCH ₂ CF ₃	Br	SO ₂ CF ₃	Br	SOCH ₂ CF ₃
Cl	SOCHF ₂	Cl	SO ₂ CF ₂ CF ₃	Br	SOCHF ₂	Br	SO ₂ CF ₂ CF ₃
Cl	SO ₂ CF ₃	Cl	SO ₂ CF ₂ CF ₂ H	Br	SO ₂ CF ₃	Br	SO ₂ CF ₂ CF ₂ H
Cl	SO ₂ CHF ₂	Cl	SOCHFCF ₃	Br	SO ₂ CHF ₂	Br	SOCHFCF ₃
Cl	CN	Cl	SO ₂ CH ₂ CF ₃	Br	CN	Br	SO ₂ CH ₂ CF ₃
Cl	I	Cl	SO ₂ CF ₂ CF ₃	Br	I	Br	SO ₂ CF ₂ CF ₃
Cl	OCH ₂ F	Cl	SO ₂ CF ₂ CF ₂ H	Br	OCH ₂ F	Br	SO ₂ CF ₂ CF ₂ H
Cl	SCH ₂ F	Cl	SO ₂ CHFCF ₃	Br	SCH ₂ F	Br	SO ₂ CHFCF ₃
Cl	Et	Cl	OCF ₂ CF ₃	Br	Et	Br	OCF ₂ CF ₃
Cl	OCF ₂ Cl	Cl	SCHFCF ₃	Br	OCF ₂ Cl	Br	SCHFCF ₃

T is F, V is I and U is Me

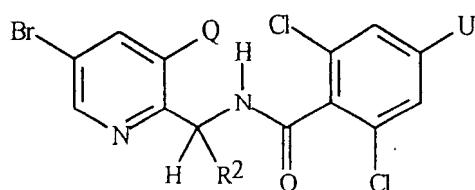
Q	R	Q	R	Q	R	Q	R
Cl	Cl	Cl	OCH ₂ CF ₃	Br	Cl	Br	OCH ₂ CF ₃
Cl	Br	Cl	OCF ₂ CF ₂ H	Br	Br	Br	OCF ₂ CF ₂ H
Cl	OCF ₃	Cl	OCHFCF ₃	Br	OCF ₃	Br	OCHFCF ₃
Cl	OCHF ₂	Cl	SCH ₂ CF ₃	Br	OCHF ₂	Br	SCH ₂ CF ₃
Cl	SCF ₃	Cl	SCF ₂ CF ₃	Br	SCF ₃	Br	SCF ₂ CF ₃
Cl	SCHF ₂	Cl	SCF ₂ CF ₂ H	Br	SCHF ₂	Br	SCF ₂ CF ₂ H
Cl	SOCF ₃	Cl	SOCH ₂ CF ₃	Br	SOCF ₃	Br	SOCH ₂ CF ₃
Cl	SOCHF ₂	Cl	SOCF ₂ CF ₃	Br	SOCHF ₂	Br	SOCF ₂ CF ₃
Cl	SO ₂ CF ₃	Cl	SOCF ₂ CF ₂ H	Br	SO ₂ CF ₃	Br	SOCF ₂ CF ₂ H
Cl	SO ₂ CHF ₂	Cl	SOCHFCF ₃	Br	SO ₂ CHF ₂	Br	SOCHFCF ₃
Cl	CN	Cl	SO ₂ CH ₂ CF ₃	Br	CN	Br	SO ₂ CH ₂ CF ₃
Cl	I	Cl	SO ₂ CF ₂ CF ₃	Br	I	Br	SO ₂ CF ₂ CF ₃
Cl	OCH ₂ F	Cl	SO ₂ CF ₂ CF ₂ H	Br	OCH ₂ F	Br	SO ₂ CF ₂ CF ₂ H
Cl	SCH ₂ F	Cl	SO ₂ CHFCF ₃	Br	SCH ₂ F	Br	SO ₂ CHFCF ₃
Cl	Et	Cl	OCF ₂ CF ₃	Br	Et	Br	OCF ₂ CF ₃
Cl	OCF ₂ Cl	Cl	SCHFCF ₃	Br	OCF ₂ Cl	Br	SCHFCF ₃

Table 5



Q	R ²	U	R	R ²	U	R	R ²	U
I	H	H	I	Me	H	I	Me	Me
OCHF ₂	H	H	OCHF ₂	Me	H	OCHF ₂	Me	Me
OCH ₂ F	H	H	OCH ₂ F	Me	H	OCH ₂ F	Me	Me
OCF ₂ Cl	H	H	OCF ₂ Cl	Me	H	OCF ₂ Cl	Me	Me
OCH ₂ CF ₃	H	H	OCH ₂ CF ₃	Me	H	OCH ₂ CF ₃	Me	Me
Et	H	H	Et	Me	H	Et	Me	Me
CN	H	H	CN	Me	H	CN	Me	Me
NH ₂	H	H	NH ₂	Me	H	NH ₂	Me	Me
NHCOMe	H	H	NHCOMe	Me	H	NHCOMe	Me	Me
NHCOCF ₃	H	H	NHCOCF ₃	Me	H	NHCOCF ₃	Me	Me
SCF ₃	H	H	SCF ₃	Me	H	SCF ₃	Me	Me
SCHF ₂	H	H	SCHF ₂	Me	H	SCHF ₂	Me	Me
SCH ₂ F	H	H	SCH ₂ F	Me	H	SCH ₂ F	Me	Me
Ph	H	H	Ph	Me	H	Ph	Me	Me
Me ₃ Si	H	H	Me ₃ Si	Me	H	Me ₃ Si	Me	Me
I	H	Me	Et	H	Me	SCF ₃	H	Me
OCHF ₂	H	Me	CN	H	Me	SCHF ₂	H	Me
OCH ₂ F	H	Me	NH ₂	H	Me	SCH ₂ F	H	Me
OCF ₂ Cl	H	Me	NHCOMe	H	Me	Ph	H	Me
OCH ₂ CF ₃	H	Me	NHCOCF ₃	H	Me	Me ₃ Si	H	Me

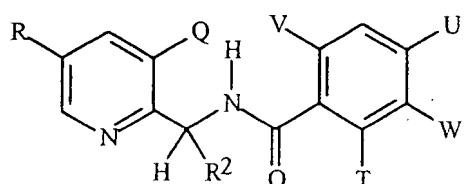
Table 6



Q	R ²	U	R	R ²	U	R	R ²	U
I	H	H	I	Me	H	I	Me	Me

Q	R ²	U	R	R ²	U	R	R ²	U
OCHF ₂	H	H	OCHF ₂	Me	H	OCHF ₂	Me	Me
OCH ₂ F	H	H	OCH ₂ F	Me	H	OCH ₂ F	Me	Me
OCF ₂ Cl	H	H	OCF ₂ Cl	Me	H	OCF ₂ Cl	Me	Me
OCH ₂ CF ₃	H	H	OCH ₂ CF ₃	Me	H	OCH ₂ CF ₃	Me	Me
Et	H	H	Et	Me	H	Et	Me	Me
CN	H	H	CN	Me	H	CN	Me	Me
NH ₂	H	H	NH ₂	Me	H	NH ₂	Me	Me
NHCOMe	H	H	NHCOMe	Me	H	NHCOMe	Me	Me
NHCOCF ₃	H	H	NHCOCF ₃	Me	H	NHCOCF ₃	Me	Me
SCF ₃	H	H	SCF ₃	Me	H	SCF ₃	Me	Me
SCHF ₂	H	H	SCHF ₂	Me	H	SCHF ₂	Me	Me
SCH ₂ F	H	H	SCH ₂ F	Me	H	SCH ₂ F	Me	Me
Ph	H	H	Ph	Me	H	Ph	Me	Me
Me ₃ Si	H	H	Me ₃ Si	Me	H	Me ₃ Si	Me	Me
I	H	Me	Et	H	Me	SCF ₃	H	Me
OCHF ₂	H	Me	CN	H	Me	SCHF ₂	H	Me
OCH ₂ F	H	Me	NH ₂	H	Me	SCH ₂ F	H	Me
OCF ₂ Cl	H	Me	NHCOMe	H	Me	Ph	H	Me
OCH ₂ CF ₃	H	Me	NHCOCF ₃	H	Me	Me ₃ Si	H	Me

Table 7



R	Q	R ²	T	W	V	U	R	Q	R ²	T	W	V	U
Cl	Cl	H	Cl	H	H	H	Br	Cl	H	Cl	H	H	H
Cl	Cl	H	NO ₂	H	H	H	Br	Cl	H	NO ₂	H	H	H
Cl	Cl	H	F	H	H	H	Br	Cl	H	F	H	H	H
Cl	Cl	H	F	F	F	H	Br	Cl	H	F	F	F	H
Cl	Cl	H	F	H	F	H	Br	Cl	H	F	H	F	H
Cl	Cl	H	F	H	Cl	H	Br	Cl	H	F	H	Cl	H
Cl	Cl	H	F	H	Br	H	Br	Cl	H	F	H	Br	H
Cl	Cl	H	F	H	OMe	H	Br	Cl	H	F	H	OMe	H
Cl	Cl	H	F	H	CF ₃	H	Br	Cl	H	F	H	CF ₃	H

R	Q	R ²	T	W	V	U	R	Q	R ²	T	W	V	U
Cl	Cl	H	Cl	H	F	H	Br	Cl	H	Cl	H	F	H
Cl	Cl	H	Cl	H	Br	H	Br	Cl	H	Cl	H	Br	H
Cl	Cl	H	Cl	H	OMe	H	Br	Cl	H	Cl	H	OMe	H
Cl	Cl	H	Cl	H	CF ₃	H	Br	Cl	H	Cl	H	CF ₃	H
Cl	Cl	H	Br	H	F	H	Br	Cl	H	Br	H	F	H
Cl	Cl	H	Br	H	Cl	H	Br	Cl	H	Br	H	Cl	H
Cl	Cl	H	Br	H	Br	H	Br	Cl	H	Br	H	Br	H
Cl	Cl	H	Br	H	I	H	Br	Cl	H	Br	H	I	H
Cl	Cl	H	Br	H	OMe	H	Br	Cl	H	Br	H	OMe	H
Cl	Cl	H	Br	H	CF ₃	H	Br	Cl	H	Br	H	CF ₃	H
Cl	Cl	H	I	H	F	H	Br	Cl	H	I	H	F	H
Cl	Cl	H	I	H	Cl	H	Br	Cl	H	I	H	Cl	H
Cl	Cl	H	I	H	Br	H	Br	Cl	H	I	H	Br	H
Cl	Cl	H	I	H	I	H	Br	Cl	H	I	H	I	H
Cl	Cl	H	I	H	OMe	H	Br	Cl	H	I	H	OMe	H
Cl	Cl	H	I	H	CF ₃	H	Br	Cl	H	I	H	CF ₃	H
Cl	Cl	H	OMe	H	F	H	Br	Cl	H	OMe	H	F	H
Cl	Cl	H	OMe	H	Cl	H	Br	Cl	H	OMe	H	Cl	H
Cl	Cl	H	OMe	H	Br	H	Br	Cl	H	OMe	H	Br	H
Cl	Cl	H	OMe	H	I	H	Br	Cl	H	OMe	H	I	H
Cl	Cl	H	OMe	H	OMe	H	Br	Cl	H	OMe	H	OMe	H
Cl	Cl	H	OMe	H	CF ₃	H	Br	Cl	H	OMe	H	CF ₃	H
Cl	Cl	H	CF ₃	H	F	H	Br	Cl	H	CF ₃	H	F	H
Cl	Cl	H	CF ₃	H	Cl	H	Br	Cl	H	CF ₃	H	Cl	H
Cl	Cl	H	CF ₃	H	Br	H	Br	Cl	H	CF ₃	H	Br	H
Cl	Cl	H	CF ₃	H	I	H	Br	Cl	H	CF ₃	H	I	H
Cl	Cl	H	CF ₃	H	OMe	H	Br	Cl	H	CF ₃	H	OMe	H
Cl	Cl	H	CF ₃	H	CF ₃	H	Br	Cl	H	CF ₃	H	CF ₃	H
Cl	Cl	H	Cl	H	H	Me	Br	Cl	H	Cl	H	H	Me
Cl	Cl	H	NO ₂	H	H	Me	Br	Cl	H	NO ₂	H	H	Me
Cl	Cl	H	F	H	H	Me	Br	Cl	H	F	H	H	Me
Cl	Cl	H	F	F	F	Me	Br	Cl	H	F	F	F	Me
Cl	Cl	H	F	H	F	Me	Br	Cl	H	F	H	F	Me
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Cl	Cl	H	F	H	Br	Me	Br	Cl	H	F	H	Br	Me
Cl	Cl	H	F	H	OMe	Me	Br	Cl	H	F	H	OMe	Me
Cl	Cl	H	F	H	CF ₃	Me	Br	Cl	H	F	H	CF ₃	Me

R	Q	R ²	T	W	V	U	R	Q	R ²	T	W	V	U
Cl	Cl	H	Cl	H	F	Me	Br	Cl	H	Cl	H	F	Me
Cl	Cl	H	Cl	H	Br	Me	Br	Cl	H	Cl	H	Br	Me
Cl	Cl	H	Cl	H	OMe	Me	Br	Cl	H	Cl	H	OMe	Me
Cl	Cl	H	Cl	H	CF ₃	Me	Br	Cl	H	Cl	H	CF ₃	Me
Cl	Cl	H	Br	H	F	Me	Br	Cl	H	Br	H	F	Me
Cl	Cl	H	Br	H	Cl	Me	Br	Cl	H	Br	H	Cl	Me
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Cl	Cl	H	Br	H	I	Me	Br	Cl	H	Br	H	I	Me
Cl	Cl	H	Br	H	OMe	Me	Br	Cl	H	Br	H	OMe	Me
Cl	Cl	H	Br	H	CF ₃	Me	Br	Cl	H	Br	H	CF ₃	Me
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Cl	Cl	H	I	H	OMe	Me	Br	Cl	H	I	H	OMe	Me
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Cl	Cl	H	OMe	H	F	Me	Br	Cl	H	OMe	H	F	Me
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Cl	Cl	H	OMe	H	OMe	Me	Br	Cl	H	OMe	H	OMe	Me
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Cl	Cl	H	CF ₃	H	F	Me	Br	Cl	H	CF ₃	H	F	Me
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Cl	Cl	H	CF ₃	H	Br	Me	Br	Cl	H	CF ₃	H	Br	Me
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Cl	Cl	H	CF ₃	H	OMe	Me	Br	Cl	H	CF ₃	H	OMe	Me
Cl	Cl	H	CF ₃	H	CF ₃	Me	Br	Cl	H	CF ₃	H	CF ₃	Me
Cl	Cl	Me	Cl	H	H	H	Br	Cl	Me	Cl	H	H	H
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Cl	Cl	Me	F	H	Br	H	Br	Cl	Me	F	H	Br	H
Cl	Cl	Me	F	H	OMe	H	Br	Cl	Me	F	H	OMe	H
Cl	Cl	Me	F	H	CF ₃	H	Br	Cl	Me	F	H	CF ₃	H

R	Q	R ²	T	W	V	U	R	Q	R ²	T	W	V	U
Cl	Cl	Me	Cl	H	F	H	Br	Cl	Me	Cl	H	F	H
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Cl	Cl	Me	Cl	H	OMe	H	Br	Cl	Me	Cl	H	OMe	H
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Cl	Cl	Me	Br	H	Cl	H	Br	Cl	Me	Br	H	Cl	H
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Cl	Cl	Me	Br	H	I	H	Br	Cl	Me	Br	H	I	H
Cl	Cl	Me	Br	H	OMe	H	Br	Cl	Me	Br	H	OMe	H
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Cl	Cl	Me	I	H	OMe	H	Br	Cl	Me	I	H	OMe	H
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Cl	Cl	Me	CF ₃	H	F	H	Br	Cl	Me	CF ₃	H	F	H
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Cl	Cl	Me	CF ₃	H	Br	H	Br	Cl	Me	CF ₃	H	Br	H
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Cl	Cl	Me	Cl	H	H	Me	Br	Cl	Me	Cl	H	H	Me
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Cl	Cl	Me	F	H	OMe	Me	Br	Cl	Me	F	H	OMe	Me
Cl	Cl	Me	F	H	CF ₃	Me	Br	Cl	Me	F	H	CF ₃	Me

R	Q	R ²	T	W	V	U	R	Q	R ²	T	W	V	U
Cl	Cl	Me	Cl	H	F	Me	Br	Cl	Me	Cl	H	F	Me
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Cl	Cl	Me	Cl	H	OMe	Me	Br	Cl	Me	Cl	H	OMe	Me
Cl	Cl	Me	Cl	H	CF ₃	Me	Br	Cl	Me	Cl	H	CF ₃	Me
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Cl	Cl	Me	Br	H	OMe	Me	Br	Cl	Me	Br	H	OMe	Me
Cl	Cl	Me	Br	H	CF ₃	Me	Br	Cl	Me	Br	H	CF ₃	Me
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Cl	Cl	Me	CF ₃	H	F	Me	Br	Cl	Me	CF ₃	H	F	Me
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Cl	Cl	Me	CF ₃	H	Br	Me	Br	Cl	Me	CF ₃	H	Br	Me
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Cl	Cl	Me	CF ₃	H	OMe	Me	Br	Cl	Me	CF ₃	H	OMe	Me
Cl	Cl	Me	CF ₃	H	CF ₃	Me	Br	Cl	Me	CF ₃	H	CF ₃	Me
Cl	Br	H	Cl	H	H	H	Br	Br	H	Cl	H	H	H
Cl	Br	H	NO ₂	H	H	H	Br	Br	H	NO ₂	H	H	H
Cl	Br	H	F	H	H	H	Br	Br	H	F	H	H	H
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Cl	Br	H	F	H	F	H	Br	Br	H	F	H	F	H
Cl	Br	H	F	H	Cl	H	Br	Br	H	F	H	Cl	H
Cl	Br	H	F	H	Br	H	Br	Br	H	F	H	Br	H
Cl	Br	H	F	H	OMe	H	Br	Br	H	F	H	OMe	H
Cl	Br	H	F	H	CF ₃	H	Br	Br	H	F	H	CF ₃	H

R	Q	R ²	T	W	V	U	R	Q	R ²	T	W	V	U
Cl	Br	H	Cl	H	F	H	Br	Br	H	Cl	H	F	H
Cl	Br	H	Cl	H	Br	H	Br	Br	H	Cl	H	Br	H
Cl	Br	H	Cl	H	OMe	H	Br	Br	H	Cl	H	OMe	H
Cl	Br	H	Cl	H	CF ₃	H	Br	Br	H	Cl	H	CF ₃	H
Cl	Br	H	Br	H	F	H	Br	Br	H	Br	H	F	H
Cl	Br	H	Br	H	Cl	H	Br	Br	H	Br	H	Cl	H
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Cl	Br	H	Br	H	OMe	H	Br	Br	H	Br	H	OMe	H
Cl	Br	H	Br	H	CF ₃	H	Br	Br	H	Br	H	CF ₃	H
Cl	Br	H	I	H	F	H	Br	Br	H	I	H	F	H
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Cl	Br	H	I	H	OMe	H	Br	Br	H	I	H	OMe	H
Cl	Br	H	I	H	CF ₃	H	Br	Br	H	I	H	CF ₃	H
Cl	Br	H	OMe	H	F	H	Br	Br	H	OMe	H	F	H
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Cl	Br	H	CF ₃	H	F	H	Br	Br	H	CF ₃	H	F	H
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Cl	Br	H	CF ₃	H	Br	H	Br	Br	H	CF ₃	H	Br	H
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Cl	Br	H	CF ₃	H	OMe	H	Br	Br	H	CF ₃	H	OMe	H
Cl	Br	H	CF ₃	H	CF ₃	H	Br	Br	H	CF ₃	H	CF ₃	H
Cl	Br	H	Cl	H	H	Me	Br	Br	H	Cl	H	H	Me
Cl	Br	H	NO ₂	H	H	Me	Br	Br	H	NO ₂	H	H	Me
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Cl	Br	H	F	H	F	Me	Br	Br	H	F	H	F	Me
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Cl	Br	H	F	H	Br	Me	Br	Br	H	F	H	Br	Me
Cl	Br	H	F	H	OMe	Me	Br	Br	H	F	H	OMe	Me
Cl	Br	H	F	H	CF ₃	Me	Br	Br	H	F	H	CF ₃	Me

R	Q	R ²	T	W	V	U	R	Q	R ²	T	W	V	U
Cl	Br	H	Cl	H	F	Me	Br	Br	H	Cl	H	F	Me
Cl	Br	H	Cl	H	Br	Me	Br	Br	H	Cl	H	Br	Me
Cl	Br	H	Cl	H	OMe	Me	Br	Br	H	Cl	H	OMe	Me
Cl	Br	H	Cl	H	CF ₃	Me	Br	Br	H	Cl	H	CF ₃	Me
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Cl	Br	H	Br	H	OMe	Me	Br	Br	H	Br	H	OMe	Me
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Cl	Br	H	I	H	OMe	Me	Br	Br	H	I	H	OMe	Me
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Cl	Br	H	CF ₃	H	OMe	Me	Br	Br	H	CF ₃	H	OMe	Me
Cl	Br	H	CF ₃	H	CF ₃	Me	Br	Br	H	CF ₃	H	CF ₃	Me
Cl	Br	Me	Cl	H	H	H	Br	Br	Me	Cl	H	H	H
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Cl	Br	Me	F	H	OMe	H	Br	Br	Me	F	H	OMe	H
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R	Q	R ²	T	W	V	U	R	Q	R ²	T	W	V	U
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Cl	Br	Me	Br	H	OMe	H	Br	Br	Me	Br	H	OMe	H
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Cl	Br	Me	OMe	H	CF ₃	H	Br	Br	Me	OMe	H	CF ₃	H
Cl	Br	Me	CF ₃	H	F	H	Br	Br	Me	CF ₃	H	F	H
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Cl	Br	Me	CF ₃	H	Br	H	Br	Br	Me	CF ₃	H	Br	H
Cl	Br	Me	CF ₃	H	I	H	Br	Br	Me	CF ₃	H	I	H
Cl	Br	Me	CF ₃	H	OMe	H	Br	Br	Me	CF ₃	H	OMe	H
Cl	Br	Me	CF ₃	H	CF ₃	H	Br	Br	Me	CF ₃	H	CF ₃	H
Cl	Br	Me	Cl	H	H	Me	Br	Br	Me	Cl	H	H	Me
Cl	Br	Me	NO ₂	H	H	Me	Br	Br	Me	NO ₂	H	H	Me
Cl	Br	Me	F	H	H	Me	Br	Br	Me	F	H	H	Me
Cl	Br	Me	F	F	F	Me	Br	Br	Me	F	F	F	Me
Cl	Br	Me	F	H	F	Me	Br	Br	Me	F	H	F	Me
Cl	Br	Me	F	H	Cl	Me	Br	Br	Me	F	H	Cl	Me
Cl	Br	Me	F	H	Br	Me	Br	Br	Me	F	H	Br	Me
Cl	Br	Me	F	H	OMe	Me	Br	Br	Me	F	H	OMe	Me
Cl	Br	Me	F	H	CF ₃	Me	Br	Br	Me	F	H	CF ₃	Me

R	Q	R ²	T	W	V	U	R	Q	R ²	T	W	V	U
Cl	Br	Me	Cl	H	F	Me	Br	Br	Me	Cl	H	F	Me
Cl	Br	Me	Cl	H	Br	Me	Br	Br	Me	Cl	H	Br	Me
Cl	Br	Me	Cl	H	OMe	Me	Br	Br	Me	Cl	H	OMe	Me
Cl	Br	Me	Cl	H	CF ₃	Me	Br	Br	Me	Cl	H	CF ₃	Me
Cl	Br	Me	Br	H	F	Me	Br	Br	Me	Br	H	F	Me
Cl	Br	Me	Br	H	Cl	Me	Br	Br	Me	Br	H	Cl	Me
Cl	Br	Me	Br	H	Br	Me	Br	Br	Me	Br	H	Br	Me
Cl	Br	Me	Br	H	I	Me	Br	Br	Me	Br	H	I	Me
Cl	Br	Me	Br	H	OMe	Me	Br	Br	Me	Br	H	OMe	Me
Cl	Br	Me	Br	H	CF ₃	Me	Br	Br	Me	Br	H	CF ₃	Me
Cl	Br	Me	I	H	F	Me	Br	Br	Me	I	H	F	Me
Cl	Br	Me	I	H	Cl	Me	Br	Br	Me	I	H	Cl	Me
Cl	Br	Me	I	H	Br	Me	Br	Br	Me	I	H	Br	Me
Cl	Br	Me	I	H	I	Me	Br	Br	Me	I	H	I	Me
Cl	Br	Me	I	H	OMe	Me	Br	Br	Me	I	H	OMe	Me
Cl	Br	Me	I	H	CF ₃	Me	Br	Br	Me	I	H	CF ₃	Me
Cl	Br	Me	OMe	H	F	Me	Br	Br	Me	OMe	H	F	Me
Cl	Br	Me	OMe	H	Cl	Me	Br	Br	Me	OMe	H	Cl	Me
Cl	Br	Me	OMe	H	Br	Me	Br	Br	Me	OMe	H	Br	Me
Cl	Br	Me	OMe	H	I	Me	Br	Br	Me	OMe	H	I	Me
Cl	Br	Me	OMe	H	OMe	Me	Br	Br	Me	OMe	H	OMe	Me
Cl	Br	Me	OMe	H	CF ₃	Me	Br	Br	Me	OMe	H	CF ₃	Me
Cl	Br	Me	CF ₃	H	F	Me	Br	Br	Me	CF ₃	H	F	Me
Cl	Br	Me	CF ₃	H	Cl	Me	Br	Br	Me	CF ₃	H	Cl	Me
Cl	Br	Me	CF ₃	H	Br	Me	Br	Br	Me	CF ₃	H	Br	Me
Cl	Br	Me	CF ₃	H	I	Me	Br	Br	Me	CF ₃	H	I	Me
Cl	Br	Me	CF ₃	H	OMe	Me	Br	Br	Me	CF ₃	H	OMe	Me
Cl	Br	Me	CF ₃	H	CF ₃	Me	Br	Br	Me	CF ₃	H	CF ₃	Me

The fungicides of component (b) of the compositions of the invention are selected from the group consisting of

(b1) alkylenebis(dithiocarbamate) fungicides;

5 (b2) compounds acting at the *bc₁* complex of the fungal mitochondrial respiratory electron transfer site;

(b3) cymoxanil;

(b4) compounds acting at the demethylase enzyme of the sterol biosynthesis pathway;

(b5) morpholine and piperidine compounds that act on the sterol biosynthesis pathway;

- (b6) phenylamide fungicides;
- (b7) pyrimidinone fungicides;
- (b8) phthalimides; and
- (b9) fosetyl-aluminum.

5 The weight ratios of component (b) to component (a) typically is from 100:1 to 1:100, preferably is from 30:1 to 1:30, and more preferably is from 10:1 to 1:10. Of note are compositions wherein the weight ratio of component (b) to component (a) is from 10:1 to 1:1. Included are compositions wherein the weight ratio of component (b) to component (a) is from 9:1 to 4.5:1.

10 The bc_1 Complex Fungicides (component (b2))

Strobilurin fungicides such as azoxystrobin, kresoxim-methyl, metominostrobin/fenominostrobin (SSF-126), picoxystrobin, pyraclostrobin and trifloxystrobin are known to have a fungicidal mode of action which inhibits the bc_1 complex in the mitochondrial respiration chain (*Angew. Chem. Int. Ed.*, 1999, 38, 1328-1349). Methyl (E)-2-[[6-(2-cyanophenoxy)-4-pyrimidinyl]oxy]- α -(methoxyimino)benzeneacetate (also known as azoxystrobin) is described as a bc_1 complex inhibitor in *Biochemical Society Transactions* 1993, 22, 68S. Methyl (E)- α -(methoxyimino)-2-[(2-methylphenoxy)methyl]benzeneacetate (also known as kresoxim-methyl) is described as a bc_1 complex inhibitor in *Biochemical Society Transactions* 1993, 20, 64S. (E)-2-[(2,5-Dimethylphenoxy)methyl]- α -(methoxyimino)-N-methylbenzeneacetamide is described as a bc_1 complex inhibitor in *Biochemistry and Cell Biology* 1995, 85(3), 306-311. Other compounds that inhibit the bc_1 complex in the mitochondrial respiration chain include famoxadone and fenamidone.

25 The bc_1 complex is sometimes referred to by other names in the biochemical literature, including complex III of the electron transfer chain, and ubihydroquinone:cytochrome c oxidoreductase. It is uniquely identified by the Enzyme Commission number EC1.10.2.2. The bc_1 complex is described in, for example, *J. Biol. Chem.* 1989, 264, 14543-38; *Methods Enzymol.* 1986, 126, 253-71; and references cited therein.

30 The Sterol Biosynthesis Inhibitor Fungicides (component (b4) or (b5))

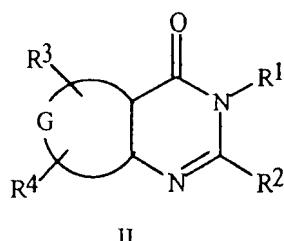
35 The class of sterol biosynthesis inhibitors includes DMI and non-DMI compounds, that control fungi by inhibiting enzymes in the sterol biosynthesis pathway. DMI fungicides have a common site of action within the fungal sterol biosynthesis pathway; that is, an inhibition of demethylation at position 14 of lanosterol or 24-methylene dihydrolanosterol, which are precursors to sterols in fungi. Compounds acting at this site are often referred to as demethylase inhibitors, DMI fungicides, or DMIs. The demethylase enzyme is sometimes referred to by other names in the biochemical literature, including cytochrome P-450 (14DM). The demethylase enzyme is described in, for example, *J. Biol. Chem.* 1992, 267, 13175-79 and references cited therein. DMI fungicides fall into several classes: azoles

(including triazoles and imidazoles), pyrimidines, piperazines and pyridines. The triazoles includes bromuconazole, cyproconazole, difenoconazole, diniconazole, epoxiconazole, fenbuconazole, fluquinconazole, flusilazole, flutriafol, hexaconazole, ipconazole, metconazole, penconazole, propiconazole, tebuconazole, tetriconazole, triadimefon, 5 triadimenol, triticonazole and uniconazole. The imidazoles include clotrimazole, econazole, imazalil, isoconazole, miconazole and prochloraz. The pyrimidines include fenarimol, nuarimol and triarimol. The piperazines include triforine. The pyridines include buthiobate and pyrifenoxy. Biochemical investigations have shown that all of the above mentioned 10 fungicides are DMI fungicides as described by K. H. Kuck, et al. in *Modern Selective Fungicides - Properties, Applications and Mechanisms of Action*, Lyr, H., Ed.; Gustav Fischer Verlag: New York, 1995, 205-258.

The DMI fungicides have been grouped together to distinguish them from other sterol biosynthesis inhibitors, such as, the morpholine and piperidine fungicides. The morpholines and piperidines are also sterol biosynthesis inhibitors but have been shown to inhibit later 15 steps in the sterol biosynthesis pathway. The morpholines include aldimorph, dodemorph, fenpropimorph, tridemorph and trimorphamide. The piperidines include fenpropidin. Biochemical investigations have shown that all of the above mentioned morpholine and piperidine fungicides are sterol biosynthesis inhibitor fungicides as described by K. H. Kuck, et al. in *Modern Selective Fungicides - Properties, Applications and Mechanisms of Action*, 20 Lyr, H., Ed.; Gustav Fischer Verlag: New York, 1995, 185-204.

Pyrimidinone Fungicides (component (b7))

Pyrimidinone fungicides include compounds of Formula II



wherein

25 G is a fused phenyl, thiophene or pyridine ring;
 R¹ is C₁-C₆ alkyl;
 R² is C₁-C₆ alkyl or C₁-C₆ alkoxy;
 R³ is halogen; and
 R⁴ is hydrogen or halogen.

30 Pyrimidinone fungicides are described in International Patent Application WO94/26722, U.S. Patent No. 6,066,638, U.S. Patent No. 6,245,770, U.S. Patent No. 6,262,058 and U.S. Patent No. 6,277,858.

Of note are pyrimidinone fungicides selected from the group:

6-bromo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone,
 6,8-diiodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone,
 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone,
 6-chloro-2-propoxy-3-propylthieno[2,3-*d*]pyrimidin-4(3*H*)-one,
 5 6-bromo-2-propoxy-3-propylthieno[2,3-*d*]pyrimidin-4(3*H*)-one,
 7-bromo-2-propoxy-3-propylthieno[3,2-*d*]pyrimidin-4(3*H*)-one,
 6-bromo-2-propoxy-3-propylpyrido[2,3-*d*]pyrimidin-4(3*H*)-one,
 6,7-dibromo-2-propoxy-3-propylthieno[3,2-*d*]pyrimidin-4(3*H*)-one, and
 3-(cyclopropylmethyl)-6-iodo-2-(propylthio)pyrido[2,3-*d*]pyrimidin-4(3*H*)-one.

10

Table 8

Examples of component (b)

- (b1) Alkylenebis(dithiocarbamate)s such as mancozeb, maneb, propineb and zineb
- (b3) Cymoxanil
- (b6) Phenylamides such as metalaxyl, benalaxyl and oxadixyl
- (b8) Phthalimids such as folpet or captan
- (b9) Fosetyl-aluminum

Other fungicides which can be included in combination with a Formula I compound or as an additional component in combination with component (a) and component (b) are acibenzolar, benalaxyl, benomyl, blasticidin-S, Bordeaux mixture (tribasic copper sulfate), carpropamid, captafol, captan, carbendazim, chloroneb, chlorothalonil, copper oxychloride, 15 copper salts such as copper sulfate and copper hydroxide, cyazofamid, cymoxanil, cyprodinil, (S)-3,5-dichloro-*N*-(3-chloro-1-ethyl-1-methyl- 2-oxopropyl)-4-methylbenzamide (RH 7281), diclocten (S-2900), diclomezine, dicloran, dimethomorph, diniconazole-M, dodemorph, dodine, edifenphos, fencaramid (SZX0722), fenpiclonil, fentin acetate, fentin hydroxide, fluazinam, fludioxonil, flumetover (RPA 403397), flutolanil, folpet, fosetyl-20 aluminum, furalaxyl, furametapyr (S-82658), iprobenfos, iprodione, isoprothiolane, iprovalicarb, kasugamycin, mancozeb, maneb, mefenoxam, mepronil, metalaxyl, metiram-zinc, myclobutanil, neo-asozin (ferric methanearsonate), oxadixyl, pencycuron, prochloraz, procymidone, propamocarb, propineb, pyrifenoxy, pyrimethanil, pyroquilon, quinoxifen, spiroxamine, sulfur, thiadiazole, thiophanate-methyl, thiram, triadimenol, tricyclazole, 25 validamycin, vinclozolin, zineb and zoxamid.

Descriptions of the commercially available compounds listed above may be found in *The Pesticide Manual, Twelfth Edition*, C.D.S. Tomlin, ed., British Crop Protection Council, 2000.

Of note are combinations of Formula I with fungicides of a different biochemical mode 30 of action (e.g. mitochondrial respiration inhibition, inhibition of protein synthesis by interference of the synthesis of ribosomal RNA or inhibition of beta-tubulin synthesis) that can be particularly advantageous for resistance management. Examples include

combinations of compounds of Formula I (e.g. Compound 1) with strobilurins such as azoxystrobin, kresoxim-methyl, pyraclostrobin and trifloxystrobin; carbendazim, mitochondrial respiration inhibitors such as famoxadone and fenamidone; benomyl, cymoxanil; dimethomorph; folpet; fosetyl-aluminum; metalaxyl; mancozeb and maneb.

5 These combinations can be particularly advantageous for resistance management, especially where the fungicides of the combination control the same or similar diseases.

Of note are combinations of Formula I with fungicides for controlling grape diseases (e.g. *Plasmopara viticola*, *Botrytis cinerea* and *Uncinula necatur*) including

alkylenebis(dithiocarbamate)s such as mancozeb, maneb, propineb and zineb, phthalimids such as folpet, copper salts such as copper sulfate and copper hydroxide, strobilurins such as azoxystrobin, pyraclostrobin and trifloxystrobin, mitochondrial respiration inhibitors such as famoxadone and fenamidone, phenylamides such as metalaxyl, phosphonates such as

fosetyl-Al, dimethomorph, pyrimidinone fungicides such as 6-iodo-3-propyl-2-propyloxy-4(3H)-quinazolinone and 6-chloro-2-propoxy-3-

15 propylthieno[2,3-*d*]pyrimidin-4(3H)-one, and other fungicides such as cymoxanil.

Of note are combinations of Formula I with fungicides for controlling potato diseases (e.g. *Phytophthora infestans*, *Alternaria solani* and *Rhizoctonia solani*) including

alkylenebis(dithiocarbamate)s such as mancozeb, maneb, propineb and zineb; copper salts such as copper sulfate and copper hydroxide; strobilurins such as pyraclostrobin and

20 trifloxystrobin; mitochondrial respiration inhibitors such as famoxadone and fenamidone; phenylamides such as metalaxyl; carbamates such as propamocarb; phenylpyridylamines such as fluazinam and other fungicides such as chlorothalonil, cyazofamid, cymoxanil, dimethomorph, zoxamid and iprovalicarb.

Of note are compositions wherein component (b) comprises at least one compound

25 from each of two different groups selected from (b1), (b2), (b3), (b4), (b5), (b6), (b7), (b8) and (b9). The weight ratio of the compound(s) of the first of these two component (b) groups to the compound(s) of the second of these component (b) groups typically is from 100:1 to 1:100, more typically from 30:1 to 1:30 and most typically from 10:1 to 1:10.

Of note are compositions wherein component (b) comprises at least one compound

30 selected from (b1), for example mancozeb, and at least one compound selected from a second component (b) group, for example, from (b2), (b3), (b6), (b7), (b8) or (b9). Of particular note are such compositions wherein the overall weight ratio of component (b) to component (a) is from 30:1 to 1:30 and the weight ratio of component (b1) to component (a) is from 10:1 to 1:1. Included are compositions wherein the weight ratio of component (b1)

35 to component (a) is from 9:1 to 4.5:1. Examples of these compositions include compositions comprising mixtures of component (a) (preferably a compound from Index Table A) with mancozeb and a compound selected from the group consisting of famoxadone, fenamidone, azoxystrobin, kresoxim-methyl, pyraclostrobin, trifloxystrobin, cymoxanil, metalaxyl,

benalaxy, oxadixyl, 6-iodo-3-propyl-2-propoxy-4(3*H*)-quinazolinone, 6-chloro-2-propoxy-3-propylthieno[2,3-*d*]pyrimidin-4(3*H*)-one, folpet, captan and fosetyl-aluminum.

Also of note are compositions wherein component (b) comprises at least one compound selected from (b2), for example famoxadone, and at least one compound selected from a second component (b) group, for example, from (b1), (b3), (b6), (b7), (b8) or (b9). Of particular note are such compositions wherein the overall weight ratio of component (b) to component (a) is from 30:1 to 1:30 and the weight ratio of component (b2) to component (a) is from 10:1 to 1:1. Included are compositions wherein the weight ratio of component (b2) to component (a) is from 9:1 to 4.5:1. Examples of these compositions include compositions comprising mixtures of component (a) (preferably a compound from Index Table A) with famoxadone and a compound selected from the group consisting of mancozeb, maneb, propineb, zineb, cymoxanil, metalaxyl, benalaxy, oxadixyl, 6-iodo-3-propyl-2-propoxy-4(3*H*)-quinazolinone, 6-chloro-2-propoxy-3-propylthieno[2,3-*d*]pyrimidin-4(3*H*)-one, folpet, captan and fosetyl-aluminum.

Also of note are compositions wherein component (b) comprises the compound of (b3), in other words cymoxanil, and at least one compound selected from a second component (b) group, for example, from (b1), (b2), (b6), (b7), (b8) or (b9). Of particular note are such compositions wherein the overall weight ratio of component (b) to component (a) is from 30:1 to 1:30 and the weight ratio of component (b3) to component (a) is from 10:1 to 1:1. Included are compositions wherein the weight ratio of component (b3) to component (a) is from 9:1 to 4.5:1. Examples of these compositions include compositions comprising mixtures of component (a) (preferably a compound from Index Table A) with cymoxanil and a compound selected from the group consisting of famoxadone, fenamidone, azoxystrobin, kresoxim-methyl, pyraclostrobin, trifloxystrobin, mancozeb, maneb, propineb, zineb, metalaxyl, benalaxy, oxadixyl, 6-iodo-3-propyl-2-propoxy-4(3*H*)-quinazolinone, 6-chloro-2-propoxy-3-propylthieno[2,3-*d*]pyrimidin-4(3*H*)-one, folpet, captan and fosetyl-aluminum.

Also of note are compositions wherein component (b) comprises at least one compound selected from (b6), for example metalaxyl, and at least one compound selected from a second component (b) group, for example, from (b1), (b2), (b3), (b7), (b8) or (b9). Of particular note are such compositions wherein the overall weight ratio of component (b) to component (a) is from 30:1 to 1:30 and the weight ratio of component (b6) to component (a) is from 10:1 to 1:3. Included are compositions wherein the weight ratio of component (b6) to component (a) is from 9:1 to 4.5:1. Examples of these compositions include compositions comprising mixtures of component (a) (preferably a compound from Index Table A) with metalaxyl or oxadixyl and a compound selected from the group consisting of famoxadone, fenamidone, azoxystrobin, kresoxim-methyl, pyraclostrobin, trifloxystrobin, cymoxanil, mancozeb, maneb, propineb, zineb, 6-iodo-3-propyl-

2-propyloxy-4(3*H*)-quinazolinone, 6-chloro-2-propoxy-3-propylthieno[2,3-*d*]pyrimidin-4(3*H*)-one, folpet, captan and fosetyl-aluminum.

Also of note are compositions wherein component (b) comprises at least one compound selected from (b7), for example 6-iodo-3-propyl-2-propyloxy-4(3*H*)-

5 quinazolinone or 6-chloro-2-propoxy-3-propylthieno[2,3-*d*]pyrimidin-4(3*H*)-one, and at least one compound selected from a second component (b) group, for example, from (b1), (b2), (b3), (b6), (b8) or (b9). Of particular note are such compositions wherein the overall weight ratio of component (b) to component (a) is from 30:1 to 1:30 and the weight ratio of component (b7) to component (a) is from 1:1 to 1:20. Included are compositions wherein
10 the weight ratio of component (b6) to component (a) is from 1:4.5 to 1:9. Examples of these compositions include compositions comprising mixtures of component (a) (preferably a compound from Index Table A) with 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone or 6-chloro-2-propoxy-3-propylthieno[2,3-*d*]pyrimidin-4(3*H*)-one and a compound selected
15 from the group consisting of famoxadone, fenamidone, azoxystrobin, kresoxim-methyl, pyraclostrobin, trifloxystrobin, cymoxanil, mancozeb, maneb, propineb, zineb, metalaxyl, benalaxyl, oxadixyl, folpet, captan and fosetyl-aluminum.

Also of note are compositions wherein component (b) comprises the compound of (b9), in other words fosetyl-aluminum, and at least one compound selected from a second component (b) group, for example, from (b1), (b2), (b3), (b6) or (b7). Of particular note are
20 such compositions wherein the overall weight ratio of component (b) to component (a) is from 30:1 to 1:30 and the weight ratio of component (b9) to component (a) is from 10:1 to 1:1. Included are compositions wherein the weight ratio of component (b9) to component (a) is from 9:1 to 4.5:1. Examples of these compositions include compositions comprising mixtures of component (a) (preferably a compound from Index Table A) with fosetyl-
25 aluminum and a compound selected from the group consisting of famoxadone, fenamidone, azoxystrobin, kresoxim-methyl, pyraclostrobin, trifloxystrobin, mancozeb, maneb, propineb, zineb, metalaxyl, benalaxyl, oxadixyl, 6-iodo-3-propyl-2-propyloxy-4(3*H*)-quinazolinone, 6-chloro-2-propoxy-3-propylthieno[2,3-*d*]pyrimidin-4(3*H*)-one, folpet, captan and cymoxanil.

Of note are combinations of compounds of Formula I with fungicides giving an even
30 broader spectrum of agricultural protection including strobilurins such as azoxystrobin, kresoxim-methyl, pyraclostrobin and trifloxystrobin; morpholines such as fenpropidine and fenpropimorph; triazoles such as bromuconazole, cyproconazole, difenoconazole, epoxyconazole, flusilazole, ipconazole, metconazole, propiconazole, tebuconazole and triticonazole; pyrimidinone fungicides, benomyl; carbendazim; chlorothalonil; 35 dimethomorph; folpet; mancozeb; maneb; quinoxifen; validamycin and vinclozolin.

Preferred 6. Preferred compositions comprise a compound of component (a) mixed with cymoxanil.

Preferred 7. Preferred compositions comprise a compound of component (a) mixed with a compound selected from (b1). More preferred is a composition wherein the compound of (b1) is mancozeb.

Preferred 8. Preferred compositions comprise a compound of component (a) mixed with a compound selected from (b2). More preferred is a composition wherein the compound of (b2) is famoxadone.

Of particular note are combinations of Compound 1 or 5 with azoxystrobin, combinations of Compound 1 or 5 with kresoxim-methyl, combinations of Compound 1 or 5 with pyclostrobin, combinations of Compound 1 or 5 with trifloxystrobin, combinations of Compound 1 or 5 with carbendazim, combinations of Compound 1 or 5 with chlorothalonil, combinations of Compound 1 or 5 with dimethomorph, combinations of Compound 1 or 5 with folpet, combinations of Compound 1 or 5 with mancozeb, combinations of Compound 1 or 5 with maneb, combinations of Compound 1 or 5 with quinoxyfen, combinations of Compound 1 or 5 with validamycin, combinations of Compound 1 or 5 with vinclozolin, Compound 1 or 5 with fenpropidine, combinations of Compound 1 or 5 with fenpropimorph, combinations of Compound 1 or 5 with bromuconazole, combinations of Compound 1 or 5 with cyproconazole, combinations of Compound 1 or 5 with difenoconazole, combinations of Compound 1 or 5 with epoxyconazole, combinations of Compound 1 or 5 with flusilazole, combinations of Compound 1 or 5 with ipconazole, combinations of Compound 1 or 5 with metconazole, combinations of Compound 1 or 5 with propiconazole, combinations of Compound 1 or 5 with tebuconazole, combinations of Compound 1 or 5 with triticonazole, combinations of Compound 1 or 5 with famoxadone, combinations of Compound 1 or 5 with fenamidone, combinations of Compound 1 or 5 with benomyl, combinations of Compound 1 or 5 with cymoxanil, combinations of Compound 1 or 5 with fosetyl-aluminum, combinations of Compound 1 or 5 with metalaxyl, combinations of Compound 1 or 5 with propineb, combinations of Compound 1 or 5 with zineb, combinations of Compound 1 or 5 with copper sulfate, combinations of Compound 1 or 5 with copper hydroxide, combinations of Compound 1 or 5 with propamocarb, combinations of Compound 1 or 5 with cyazofamid, combinations of Compound 1 or 5 with zoxamid, combinations of Compound 1 or 5 with fluazinam and combinations of Compound 1 or 5 with iprovalicarb. Compound numbers refer to compounds in Index Table A.

Formulation/Utility

Compositions of this invention will generally be used as a formulation or composition comprising at least one carrier selected from agriculturally suitable liquid diluents, solid diluents and surfactants. The formulation or composition ingredients are selected to be consistent with the physical properties of the active ingredient, mode of application and environmental factors such as soil type, moisture and temperature. Useful formulations include liquids such as solutions (including emulsifiable concentrates), suspensions,

emulsions (including microemulsions and/or suspoemulsions) and the like which optionally can be thickened into gels. Useful formulations further include solids such as dusts, powders, granules, pellets, tablets, films, and the like which can be water-dispersible ("wettable") or water-soluble. Active ingredient can be (micro)encapsulated and further

5 formed into a suspension or solid formulation; alternatively the entire formulation of active ingredient can be encapsulated (or "overcoated"). Encapsulation can control or delay release of the active ingredient. Sprayable formulations can be extended in suitable media and used at spray volumes from about one to several hundred liters per hectare. High-strength compositions are primarily used as intermediates for further formulation.

10 The formulations will typically contain effective amounts (e.g. from 0.01-99.99 weight percent) of active ingredients together with diluent and/or surfactant within the following approximate ranges which add up to 100 percent by weight.

	Weight Percent		
	<u>Active Ingredients</u>	<u>Diluent</u>	<u>Surfactant</u>
Water-Dispersible and Water-soluble Granules, Tablets and Powders.	5-90	0-94	1-15
Suspensions, Emulsions, Solutions (including Emulsifiable Concentrates)	5-50	40-95	0-25
Dusts	1-25	70-99	0-5
Granules and Pellets	0.01-99	5-99.99	0-15
High Strength Compositions	90-99	0-10	0-2

Typical solid diluents are described in Watkins, et al., *Handbook of Insecticide Dust Diluents and Carriers*, 2nd Ed., Dorland Books, Caldwell, New Jersey. Typical liquid diluents are described in Marsden, *Solvents Guide*, 2nd Ed., Interscience, New York, 1950. McCutcheon's *Detergents and Emulsifiers Annual*, Allured Publ. Corp., Ridgewood, New Jersey, as well as Sisely and Wood, *Encyclopedia of Surface Active Agents*, Chemical Publ. Co., Inc., New York, 1964, list surfactants and recommended uses. All formulations can contain minor amounts of additives to reduce foam, caking, corrosion, microbiological growth and the like, or thickeners to increase viscosity.

Surfactants include, for example, polyethoxylated alcohols, polyethoxylated alkylphenols, polyethoxylated sorbitan fatty acid esters, dialkyl sulfosuccinates, alkyl sulfates, alkylbenzene sulfonates, organosilicones, *N,N*-dialkyltaurates, lignin sulfonates, naphthalene sulfonate formaldehyde condensates, polycarboxylates, and 25 polyoxyethylene/polyoxypropylene block copolymers. Solid diluents include, for example, clays such as bentonite, montmorillonite, attapulgite and kaolin, starch, sugar, silica, talc, diatomaceous earth, urea, calcium carbonate, sodium carbonate and bicarbonate, and sodium sulfate. Liquid diluents include, for example, water, *N,N*-dimethylformamide, dimethyl

sulfoxide, *N*-alkylpyrrolidone, ethylene glycol, polypropylene glycol, paraffins, alkylbenzenes, alkynaphthalenes, oils of olive, castor, linseed, tung, sesame, corn, peanut, cotton-seed, soybean, rape-seed and coconut, fatty acid esters, ketones such as cyclohexanone, 2-heptanone, isophorone and 4-hydroxy-4-methyl-2-pentanone, and alcohols

5 such as methanol, cyclohexanol, decanol and tetrahydrofurfuryl alcohol.

Solutions, including emulsifiable concentrates, can be prepared by simply mixing the ingredients. Dusts and powders can be prepared by blending and, usually, grinding as in a hammer mill or fluid-energy mill. Suspensions are usually prepared by wet-milling; see, for example, U.S. 3,060,084. Preferred suspension concentrates include those containing, in

10 addition to the active ingredient, from 5 to 20% nonionic surfactant (for example, polyethoxylated fatty alcohols) optionally combined with 50-65% liquid diluents and up to 5% anionic surfactants. Granules and pellets can be prepared by spraying the active material upon preformed granular carriers or by agglomeration techniques. See Browning,

15 "Agglomeration", *Chemical Engineering*, December 4, 1967, pp 147-48, *Perry's Chemical Engineer's Handbook*, 4th Ed., McGraw-Hill, New York, 1963, pages 8-57 and following, and WO 91/13546. Pellets can be prepared as described in U.S. 4,172,714.

Water-dispersible and water-soluble granules can be prepared as taught in U.S. 4,144,050, U.S. 3,920,442 and DE 3,246,493. Tablets can be prepared as taught in U.S. 5,180,587, U.S. 5,232,701 and U.S. 5,208,030. Films can be prepared as taught in GB 2,095,558 and U.S. 20 3,299,566.

For further information regarding the art of formulation, see U.S. 3,235,361, Col. 6, line 16 through Col. 7, line 19 and Examples 10-41; U.S. 3,309,192, Col. 5, line 43 through Col. 7, line 62 and Examples 8, 12, 15, 39, 41, 52, 53, 58, 132, 138-140, 162-164, 166, 167 and 169-182; U.S. 2,891,855, Col. 3, line 66 through Col. 5, line 17 and Examples 1-4; 25 Klingman, *Weed Control as a Science*, John Wiley and Sons, Inc., New York, 1961, pp 81-96; and Hance et al., *Weed Control Handbook*, 8th Ed., Blackwell Scientific Publications, Oxford, 1989.

In the following Examples, all percentages are by weight and all formulations are prepared in conventional ways. Without further elaboration, it is believed that one skilled in the art using the preceding description can utilize the present invention to its fullest extent. The following Examples are, therefore, to be construed as merely illustrative, and not limiting of the disclosure in any way whatsoever. Percentages are by weight except where otherwise indicated.

Example AWettable Powder

	Active ingredients	65.0%
	dodecylphenol polyethylene glycol ether	2.0%
5	sodium ligninsulfonate	4.0%
	sodium silicoaluminate	6.0%
	montmorillonite (calcined)	23.0%.

Example BGranule

10	Active ingredients	10.0%
	attapulgite granules (low volatile matter, 0.71/0.30 mm; U.S.S. No. 25-50 sieves)	90.0%.

Example CExtruded Pellet

15	Active ingredients	25.0%
	anhydrous sodium sulfate	10.0%
	crude calcium ligninsulfonate	5.0%
	sodium alkylnaphthalenesulfonate	1.0%
	calcium/magnesium bentonite	59.0%.

Example DEmulsifiable Concentrate

	Active ingredients	20.0%
	blend of oil soluble sulfonates	
25	and polyoxyethylene ethers	10.0%
	isophorone	70.0%.

Example ESuspension Concentrate

	Active ingredients	20.0%
	polyethoxylated fatty alcohol	15.0%
30	ester derivative of montan wax	3.0%
	calcium lignosulfonate	2.0%
	polyethoxylated/polypropoxylated	
	polyglycol block copolymer	1.0%
	propylene glycol	6.4%
35	poly(dimethylsiloxane)	0.6%
	antimicrobial agent	0.1%
	water	51.9%

The formulation ingredients are mixed together as a syrup, the active ingredients are added and the mixture is homogenized in a blender. The resulting slurry is then wet-milled to form a suspension concentrate.

Compositions of this invention can also be mixed with one or more insecticides,

5 nematocides, bactericides, acaricides, growth regulators, chemosterilants, semiochemicals, repellents, attractants, pheromones, feeding stimulants or other biologically active compounds to form a multi-component pesticide giving an even broader spectrum of agricultural protection. Examples of such agricultural protectants with which compositions of this invention can be formulated are: insecticides such as abamectin, acephate, azinphos-methyl, bifenthrin, buprofezin, carbofuran, chlорfenapyr, chlорpyrifos, chlорpyrifos-methyl, cyfluthrin, beta-cyfluthrin, cyhalothrin, lambda-cyhalothrin, 10 deltamethrin, diafenthiuron, diazinon, dislubenzuron, dimethoate, esfenvalerate, fenoxycarb, fenpropathrin, fenvalerate, fipronil, flucythrinate, tau-fluvalinate, fonophos, imidacloprid, isofenphos, malathion, metaldehyde, methamidophos, methidathion, methomyl, methoprene, 15 methoxychlor, methyl 7-chloro-2,5-dihydro-2-[[N-(methoxycarbonyl)-N-[4-(trifluoromethoxy)phenyl]amino]carbonyl]indeno[1,2-e][1,3,4]oxadiazine-4a(3H)-carboxylate (indoxacarb), monocrotophos, oxamyl, parathion, parathion-methyl, permethrin, phorate, phosalone, phosmet, phosphamidon, pirimicarb, profenofos, rotenone, sulprofos, 20 tebufenozide, tefluthrin, terbufos, tetrachlorvinphos, thiodicarb, tralomethrin, trichlorfon and triflumuron; bactericides such as streptomycin; acaricides such as amitraz, chinomethionat, chlorobenzilate, cyhexatin, dicofol, dienochlor, etoxazole, fenazaquin, fenbutatin oxide, fenpropathrin, fenpyroximate, hexythiazox, propargite, pyridaben and tebufenpyrad; 25 nematocides such as aldoxycarb and fenamiphos; and biological agents such as *Bacillus thuringiensis*, *Bacillus thuringiensis* delta endotoxin, baculovirus, and entomopathogenic bacteria, virus and fungi. The weight ratios of these various mixing partners to compounds of Formula I of this invention typically are between 100:1 and 1:100, preferably between 30:1 and 1:30, more preferably between 10:1 and 1:10 and most preferably between 4:1 and 1:4.

The compositions of this invention are useful as plant disease control agents. The 30 present invention therefore further comprises a method for controlling plant diseases caused by fungal plant pathogens comprising applying to the plant or portion thereof to be protected, or to the plant seed or seedling to be protected, an effective amount of a compound of the invention or a fungicidal composition containing said compound. The compounds and compositions of this invention provide control of diseases caused by a broad spectrum of fungal plant pathogens in the Basidiomycete, Ascomycete, Oomycete and 35 Deuteromycete classes. They are effective in controlling a broad spectrum of plant diseases, particularly foliar pathogens of ornamental, vegetable, field, cereal, and fruit crops. These pathogens include *Plasmopara viticola*, *Phytophthora infestans*, *Peronospora tabacina*,

*Pseudoperonospora cubensis, Pythium aphanidermatum, Alternaria brassicae, Septoria nodorum, Septoria tritici, Cercosporidium personatum, Cercospora arachidicola, Pseudocercospora herpotrichoides, Cercospora beticola, Botrytis cinerea, Monilinia fructicola, Pyricularia oryzae, Podosphaera leucotricha, Venturia inaequalis, Erysiphe 5 graminis, Uncinula necatur, Puccinia recondita, Puccinia graminis, Hemileia vastatrix, Puccinia striiformis, Puccinia arachidis, Rhizoctonia solani, Sphaerotheca fuliginea, Fusarium oxysporum, Verticillium dahliae, Pythium aphanidermatum, Phytophthora megasperma, Sclerotinia sclerotiorum, Sclerotium rolfsii, Erysiphe polygoni, Pyrenophora teres, Gaeumannomyces graminis, Rynchosporium secalis, Fusarium roseum, Bremia 10 lactucae and other genera and species closely related to these pathogens. The compositions of the invention are especially effective in controlling *Plasmopara viticola* on grapes and *Phytophthora infestans* on potatoes and tomatoes.*

Plant disease control is ordinarily accomplished by applying an effective amount of a compound of this invention either pre- or post-infection, to the portion of the plant to be protected such as the roots, stems, foliage, fruit, seeds, tubers or bulbs, or to the media (soil or sand) in which the plants to be protected are growing. The compounds can also be applied to the seed to protect the seed and seedling.

Rates of application for these compounds can be influenced by many factors of the environment and should be determined under actual use conditions. Foliage can normally be protected when treated at a rate of from less than 1 g/ha to 5,000 g/ha of active ingredient. 20 Seed and seedlings can normally be protected when seed is treated at a rate of from 0.1 to 10 g per kilogram of seed.

Synergism has been described as "the cooperative action of two components of a mixture, such that the total effect is greater or more prolonged than the sum of the effects of 25 the two (or more) taken independently" (see Tames, P. M. L., *Neth. J. Plant Pathology*, 1964, 70, 73-80). It is found that compositions containing the compound of Formula I and fungicides with a different mode of action exhibit synergistic effects.

The presence of a synergistic effect between two active ingredients (e.g. component (a) and component (b)) is established with the aid of the Colby equation (see Colby, S. R. In 30 *Calculating Synergistic and Antagonistic Responses of Herbicide Combinations*, Weeds, 1967, 15, 20-22):

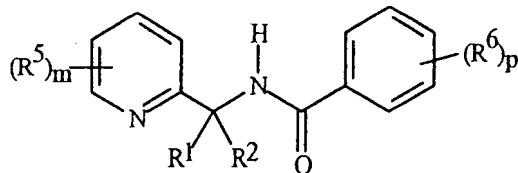
$$p = A + B - \left[\frac{A \times B}{100} \right]$$

Using the methods of Colby, the presence of a synergistic interaction between two active ingredients is established by first calculating the predicted activity, p, of the mixture based on activities of the two components applied alone. If p is lower than the 35 experimentally established effect, synergism has occurred. In the equation above, A is the

fungicidal activity in percentage control of one component applied alone at rate x. The B term is the fungicidal activity in percentage control of the second component applied at rate y. The equation estimates p, the fungicidal activity of the mixture of A at rate x with B at rate y if their effects are strictly additive and no interaction has occurred.

5 The following TESTS can be used to demonstrate the control efficacy of compositions of this invention on specific pathogens. The pathogen control protection afforded by the compositions is not limited, however, to these species. See Index Tables A for compound designations for component (a) compounds used in the TESTS.

Index Table A



10

Cmpd No.	(R ⁵) _m	R ¹	R ²	(R ⁶) _p	m. p. (° C)
1	3-Cl-5-CF ₃	H	H	2,6-di-Cl	164-168
2	3-Cl-5-CF ₃	H	CH ₃	2,6-di-Cl	
3	3-Cl-5-CF ₃	H	H	2,6-di-Cl-4-CH ₃	
4	3-Cl-5-CF ₃	H	CH ₃	2,6-di-Cl-4-CH ₃	
5	3,5-di-Cl	H	H	2,6-di-Cl	
6	3,5-di-Cl	H	CH ₃	2,6-di-Cl	
7	3,5-di-Cl	H	H	2,6-di-Cl-4-CH ₃	
8	3,5-di-Cl	H	CH ₃	2,6-di-Cl-4-CH ₃	

BIOLOGICAL EXAMPLES OF THE INVENTION

The following TESTS demonstrate the control efficacy of compositions of this invention on specific pathogens. The pathogen control protection afforded by the compounds is not limited, however, to these species.

15 Test suspensions comprising a single active ingredient are sprayed to demonstrate the control efficacy of the active ingredient individually. To demonstrate the control efficacy of a combination, (a) the active ingredients can be combined in the appropriate amounts in a single test suspension, (b) stock solutions of individual active ingredients can be prepared and then combined in the appropriate ratio, and diluted to the final desired concentration to form a test suspension or (c) test suspensions comprising single active ingredients can be sprayed sequentially in the desired ratio.

20

Composition 1

Ingredients	Wt. %
Compound 1 Technical Material	20
Polyethoxylated stearyl alcohol	15
Montan wax ester	3
Desugared calcium lignosulfate	2
Polyoxypropylene-polyoxyethylene block copolymer	1
Propylene Glycol	6.4
Polyorganosiloxanes + emulsifying agent	0.6
19% (1,2-benzisothiazolin-3-one) in aqueous dipropylene glycol	0.1
Water	51.9

Composition 2

Ingredients	Wt. %
Famoxadone Technical Material	51.7
Sodium lignosulfate	36.0
Sodium alkyl naphthalene sulfonate	2.0
Polyvinyl pyrrolidone	4.0
Polyoxypropylene-polyoxyethylene block copolymer	3.0
Sodium dodecylbenzene sulfonate	3.0
Fluoroalkyl acid mixture	0.3

Composition 3

Ingredients	Wt. %
Cymoxanil Technical Material	61.9
Sodium alkyl naphthalene sulfonate formaldehyde condensate	5.0
Sodium alkyl naphthalene sulfonate	1.0
Polyvinyl pyrrolidone	4.0
Monosodium phosphate	4.0
Fumaric acid	1.0
Fumed silica	1.0
Sodium	0.2
Sugar	14.0
Sodium lignosulfate	7.9

Test compositions were first mixed with purified water containing 250 ppm of the 5 surfactant Trem® 014 (polyhydric alcohol esters). The resulting test suspensions were then used in the following tests. Test suspensions were sprayed to the point of run-off on the test plants at the equivalent rates of 5, 10, 20, 25, 50 or 100 g/ha of active ingredient. Spraying a 40 ppm test suspension to the point of run-off on the test plants is the equivalent of a rate of

100 g/ha. The tests were replicated three times and the results reported as the average of the three replicates.

TEST A (Preventive Control)

5 The test suspensions were sprayed to the point of run-off on Potato seedlings. The following day the seedlings were inoculated with a spore suspension of *Phytophthora infestans* (the causal agent of tomato and potato late blight) and incubated in a saturated atmosphere at 20 °C for 24 hours, and then moved to a growth chamber at 20 °C for 5 days, after which disease ratings were made.

TEST B (Curative Control)

10 Potato seedlings were inoculated with a spore suspension of *Phytophthora infestans* (the causal agent of tomato and potato late blight) 24 hours prior to application and incubated in a saturated atmosphere at 20 °C for 24 hours. The test suspensions were then sprayed to the point of run-off on the potato seedlings. The following day the seedlings were moved to a growth chamber at 20 °C for 5 days, after which disease ratings were made.

15 TEST C (Extended Preventive Control)

20 The test suspensions was sprayed to the point of run-off on potato seedlings. Six days later, the seedlings were inoculated with a spore suspension of *Phytophthora infestans* (the causal agent of tomato and potato late blight) and incubated in a saturated atmosphere at 20 °C for 24 h, and then moved to a growth chamber at 20 °C for 5 days, after which disease ratings were made.

25 Results for Tests A-C are given in Table A. In the table, a rating of 100 indicates 100% disease control and a rating of 0 indicates no disease control (relative to the controls). Columns labeled Avg indicates the average of three replications. Columns labeled Exp indicate the expected value for each treatment mixture using the Colby equation. Tests demonstrating control greater than expected are indicated with *.

Table A

Composition	Number	Rate	Test A		Test B		Test C	
			Avg	Exp	Avg	Exp	Avg	Exp
	1	5	0	xx	0	xx	0	xx
	1	10	32	xx	0	xx	37	xx
	1	20	100	xx	0	xx	98	xx
	2	25	100	xx	0	xx	0	xx
	2	50	100	xx	0	xx	0	xx
	2	100	100	xx	0	xx	0	xx
	3	25	0	xx	0	xx	0	xx
	3	50	0	xx	0	xx	0	xx
	3	100	32	xx	0	xx	0	xx

<u>Composition</u>	<u>Number</u>	<u>Rate</u>	<u>Test A</u>		<u>Test B</u>		<u>Test C</u>	
			<u>Avg</u>	<u>Exp</u>	<u>Avg</u>	<u>Exp</u>	<u>Avg</u>	<u>Exp</u>
1 + 2		5 + 25	100	100	0	0	0	0
1 + 2		10 + 50	100	100	0	0	75*	37
1 + 2		20 + 100	100	100	0	0	99	98
1 + 3		5 + 25	0	0	0	0	37*	0
1 + 3		10 + 50	100*	32	0	0	88*	37
1 + 3		20 + 100	100	100	9	0	76	98

Based on the description of synergism developed by Colby, compositions of the present invention are illustrated to be synergistically useful. Moreover, compositions comprising components (a) and (b) alone can be conveniently mixed with an optional diluent prior to applying to the crop to be protected. Accordingly, this invention provides an

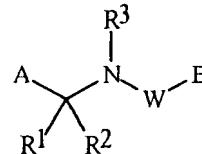
5 improved method of combating fungi, particularly fungi of the class Oomycetes such as *Phytophthora* spp. and *Plasmopara* spp., in crops, especially potatoes, grapes and tomatoes.

CLAIMS

What is claimed is:

1. A composition for controlling plant diseases caused by fungal plant pathogens comprising:

5 (a) at least one compound of Formula I, *N*-oxides and agriculturally suitable salts thereof



I

wherein

A is a substituted pyridinyl ring;

10 B is a substituted phenyl ring;

W is C=L or SO_n;

L is O or S;

R¹ and R² are each independently H; or C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl or C₃-C₆ cycloalkyl, each optionally substituted;

15 R³ is H; or C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₃-C₆ cycloalkyl, C₂-C₁₀ alkoxyalkyl, C₂-C₆ alkylcarbonyl, C₂-C₆ alkoxy carbonyl, C₂-C₆ alkylaminocarbonyl or C₃-C₈ dialkylaminocarbonyl; and

n is 1 or 2; and

(b) at least one compound selected from the group consisting of

20 (b1) alkylenebis(dithiocarbamate) fungicides;

(b2) compounds acting at the bc₁ complex of the fungal mitochondrial respiratory electron transfer site;

(b3) cymoxanil;

(b4) compounds acting at the demethylase enzyme of the sterol biosynthesis pathway;

25 (b5) morpholine and piperidine compounds that act on the sterol biosynthesis pathway;

(b6) phenylamide fungicides;

(b7) pyrimidinone fungicides;

(b8) phthalimides; and

(b9) fosetyl-aluminum.

30 2. A composition of Claim 1 in which component (a) is a compound of Formula I

wherein

A is a pyridinyl ring substituted with from 1 to 4 R⁵;

B is a phenyl ring substituted with from 1 to 4 R⁶;

W is C=O;

R¹ and R² are each independently H; or C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl or C₃-C₆ cycloalkyl, each optionally substituted with one or more substituents selected from the group consisting of halogen, CN, NO₂, hydroxy, C₁-C₄ alkoxy, C₁-C₄ alkylthio, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₂-C₄ alkoxy carbonyl, C₁-C₄ alkylamino, C₂-C₈ dialkylamino and C₃-C₆ cycloalkylamino;

R³ is H; and

each R⁵ and R⁶ is independently C₁-C₆ alkyl, C₂-C₆ alkenyl, C₂-C₆ alkynyl, C₃-C₆ cycloalkyl, C₁-C₆ haloalkyl, C₂-C₆ haloalkenyl, C₂-C₆ haloalkynyl, C₃-C₆ halocycloalkyl, halogen, CN, CO₂H, CONH₂, NO₂, hydroxy, C₁-C₄ alkoxy, C₁-C₄ haloalkoxy, C₁-C₄ alkylthio, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₁-C₄ haloalkylthio, C₁-C₄ haloalkylsulfinyl, C₁-C₄ haloalkylsulfonyl, C₁-C₄ alkylamino, C₂-C₈ dialkylamino, C₃-C₆ cycloalkylamino, C₂-C₆ alkylcarbonyl, C₂-C₆ alkoxy carbonyl, C₂-C₆ alkylaminocarbonyl, C₃-C₈ dialkylaminocarbonyl or C₃-C₆ trialkylsilyl; or

each R⁵ and R⁶ is independently a phenyl, a benzyl, a phenoxy, a 5- or 6-membered heteroaromatic ring or a 5- or 6-membered nonaromatic heterocyclic ring, each ring optionally substituted with from one to three substituents independently selected from R⁷; or

two R⁶ attached to contiguous carbon atoms are taken together with said carbon atoms to form a fused phenyl ring, a fused 5- or 6-membered nonaromatic carbocyclic ring, a fused 5- or 6-membered heteroaromatic ring or a fused 5- or 6-membered nonaromatic heterocyclic ring, each fused ring optionally substituted with from one to three substituents independently selected from R⁷;

each R⁷ is independently C₁-C₄ alkyl, C₂-C₄ alkenyl, C₂-C₄ alkynyl, C₃-C₆ cycloalkyl, C₁-C₄ haloalkyl, C₂-C₄ haloalkenyl, C₂-C₄ haloalkynyl, C₃-C₆ halocycloalkyl, halogen, CN, NO₂, C₁-C₄ alkoxy, C₁-C₄ haloalkoxy, C₁-C₄ alkylthio, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₁-C₄ alkylamino, C₂-C₈ dialkylamino, C₃-C₆ cycloalkylamino, C₃-C₆ (alkyl)cycloalkylamino, C₂-C₄ alkylcarbonyl, C₂-C₆ alkoxy carbonyl, C₂-C₆ alkylaminocarbonyl, C₃-C₈ dialkylaminocarbonyl or C₃-C₆ trialkylsilyl.

3. A composition of Claim 2 wherein component (b) is cymoxanil.
4. A composition of Claim 2 wherein component (b) is a compound selected from (b2).
5. A composition of Claim 4 wherein component (b) is famoxadone.

6. The composition of Claim 1 wherein component (b) comprises at least one compound from each of two different groups selected from (b1), (b2), (b3), (b4), (b5), (b6), (b7), (b8) and (b9).

7. The composition of Claim 6 wherein component (b) comprises at least one compound selected from (b2) and at least one compound selected from (b1), (b3), (b6), (b7), (b8) or (b9); wherein the overall weight ratio of component (b) to component (a) is from 30:1 to 1:30; and wherein the weight ratio of component (b2) to component (a) is from 10:1 to 1:1.

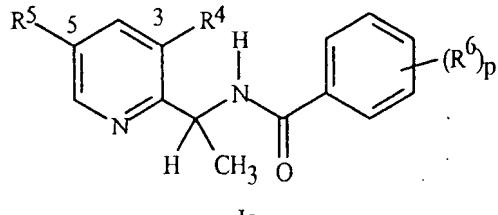
8. The composition of Claim 6 wherein component (b) comprises cymoxanil and at least one compound selected from (b1), (b2), (b6), (b7), (b8) or (b9); wherein the overall weight ratio of component (b) to component (a) is from 30:1 to 1:30; and wherein the weight ratio of cymoxanil to component (a) is from 10:1 to 1:1.

9. A method for controlling plant diseases caused by fungal plant pathogens comprising applying to the plant or portion thereof, or to the plant seed or seedling, a fungicidally effective amount of a composition of Claim 1.

10. The method of Claim 9 wherein the disease to be controlled is caused by the fungal pathogen *Phytophthora infestans*.

11. The method of Claim 9 wherein the disease to be controlled is caused by the fungal pathogen *Plasmopara viticola*.

20 12. A compound of Formula Ia and *N*-oxides and agriculturally suitable salts thereof



wherein

R⁴ is halogen;

R⁵ is C₁-C₆ alkyl, halogen, NO₂, C₁-C₄ alkoxy, C₁-C₄ haloalkoxy, C₁-C₄ alkylthio,

25 C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₁-C₄ haloalkylthio, C₁-C₄ haloalkylsulfinyl or C₁-C₄ haloalkylsulfonyl;

each R⁶ is independently C₁-C₆ alkyl, C₁-C₆ haloalkyl, halogen, NO₂, C₁-C₄ alkoxy,

C₁-C₄ haloalkoxy, C₁-C₄ alkylthio, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl,

C₁-C₄ haloalkylthio, C₁-C₄ haloalkylsulfinyl or C₁-C₄ haloalkylsulfonyl; or

30 two R⁶ attached to contiguous carbon atoms are taken together with said carbon atoms to form a fused 5- or 6-membered nonaromatic heterocyclic ring containing one

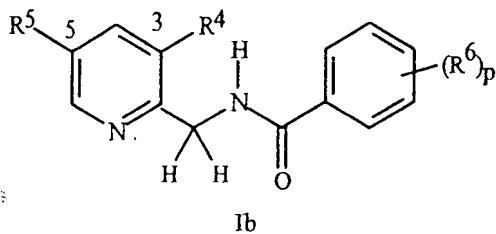
or two oxygen atoms and optionally substituted with from one to four substituents independently selected from F or methyl; and

p is 1, 2, 3 or 4.

13. The compound of Claim 12 wherein R⁵ is Cl, Br, I, CH₃, OCF₃, OCHF₂,

5 OCH₂CF₃, OCF₂CF₃, OCF₂CF₂H, OCHFCF₃, SCF₃, SCHF₂, SCH₂CF₃, SCF₂CF₃, SCF₂CF₂H, SCHFCF₃, SOCF₃, SOCHF₂, SOCH₂CF₃, SOCF₂CF₃, SOCF₂CF₂H, SOCHFCF₃, SO₂CF₃, SO₂CHF₂, SO₂CH₂CF₃, SO₂CF₂CF₃, SO₂CF₂CF₂H or SO₂CHFCF₃.

14. A compound of Formula Ib and N-oxides and agriculturally suitable salts thereof



10

wherein

R⁴ is halogen;

R⁵ is C₁-C₄ haloalkoxy, C₁-C₄ haloalkylthio, C₁-C₄ haloalkylsulfinyl or C₁-C₄ haloalkylsulfonyl;

15 each R⁶ is independently C₁-C₆ alkyl, C₁-C₆ haloalkyl, halogen, NO₂, C₁-C₄ alkoxy, C₁-C₄ haloalkoxy, C₁-C₄ alkylthio, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₁-C₄ haloalkylthio, C₁-C₄ haloalkylsulfinyl or C₁-C₄ haloalkylsulfonyl; or

two R⁶ attached to contiguous carbon atoms are taken together with said carbon atoms to form a fused 5- or 6-membered nonaromatic heterocyclic ring containing one or two oxygen atoms and optionally substituted with from one to four substituents independently selected from F or methyl; and

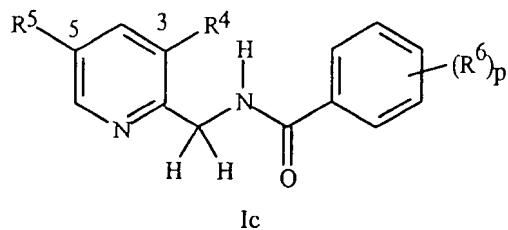
p is 1, 2, 3 or 4.

15. The compound of Claim 14 wherein R⁵ is OCF₃, OCHF₂, OCH₂CF₃, OCF₂CF₃,

OCF₂CF₂H, OCHFCF₃, SCF₃, SCHF₂, SCH₂CF₃, SCF₂CF₃, SCF₂CF₂H, SCHFCF₃,

25 SOCF₃, SOCHF₂, SOCH₂CF₃, SOCF₂CF₃, SOCF₂CF₂H, SOCHFCF₃, SO₂CF₃, SO₂CHF₂, SO₂CH₂CF₃, SO₂CF₂CF₃, SO₂CF₂CF₂H or SO₂CHFCF₃.

16. A compound of Formula Ic and N-oxides and agriculturally suitable salts thereof



wherein

R⁴ is Cl or Br;

R⁵ is Br or I;

5 each R⁶ is independently C₁-C₆ alkyl, C₁-C₆ haloalkyl, halogen, NO₂, C₁-C₄ alkoxy, C₁-C₄ haloalkoxy, C₁-C₄ alkylthio, C₁-C₄ alkylsulfinyl, C₁-C₄ alkylsulfonyl, C₁-C₄ haloalkylthio, C₁-C₄ haloalkylsulfinyl or C₁-C₄ haloalkylsulfonyl; or

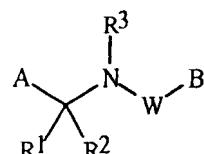
10 two R⁶ attached to contiguous carbon atoms are taken together with said carbon atoms to form a fused 5- or 6-membered nonaromatic heterocyclic ring containing one or two oxygen atoms and optionally substituted with from one to four substituents independently selected from F or methyl; and

p is 1, 2, 3 or 4.

TITLEBENZAMIDES AND ADVANTAGEOUS COMPOSITIONS THEREOF FOR USE
AS FUNGICIDESABSTRACT OF THE DISCLOSURE

5 Compositions for controlling plant diseases caused by fungal plant pathogens are described, comprising:

(a) a fungicidally effective amount of a compound of Formula I (including all geometric and stereoisomers, *N*-oxides, and agriculturally suitable salts thereof)



10 wherein A, B, W, R¹, R², and R³ are as defined in the disclosure; and

(b) at least one compound selected from the group consisting of

(b1) alkylenebis(dithiocarbamate) fungicides; (b2) compounds acting at the *bc*₁ complex of the fungal mitochondrial respiratory electron transfer site; (b3) cymoxanil; (b4) compounds acting at the demethylase enzyme of the sterol biosynthesis pathway; (b5) morpholine and

15 piperidine compounds that act on the sterol biosynthesis pathway; (b6) phenylamide fungicides; (b7) pyrimidinone fungicides; (b8) phthalimides; and (b9) fosetyl-aluminum.

Also disclosed are methods for controlling plant diseases caused by fungal plant pathogens that involves applying an effective amount of the combinations described.

Also disclosed are certain compounds of Formula I.